Gas Journal

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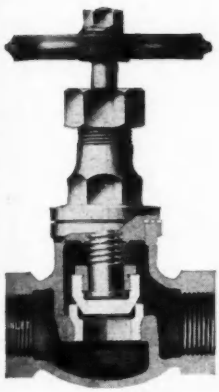

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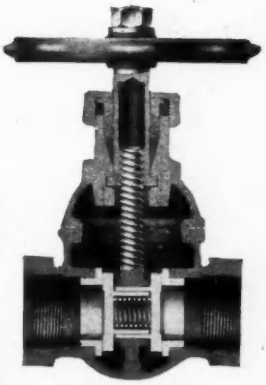

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Gas Journal

VOL. 295 NO. 4963 27 AUGUST, 1958

110TH YEAR

MANAGING DIRECTOR: Clifford A. King

EDITOR: Geoffrey W. Battison

ASSISTANT EDITOR: Colin J. Godbold

TECHNICAL EDITOR: Charles J. P. de Winton, T.D., M.A., M.Inst. Gas E., M. Inst. F.

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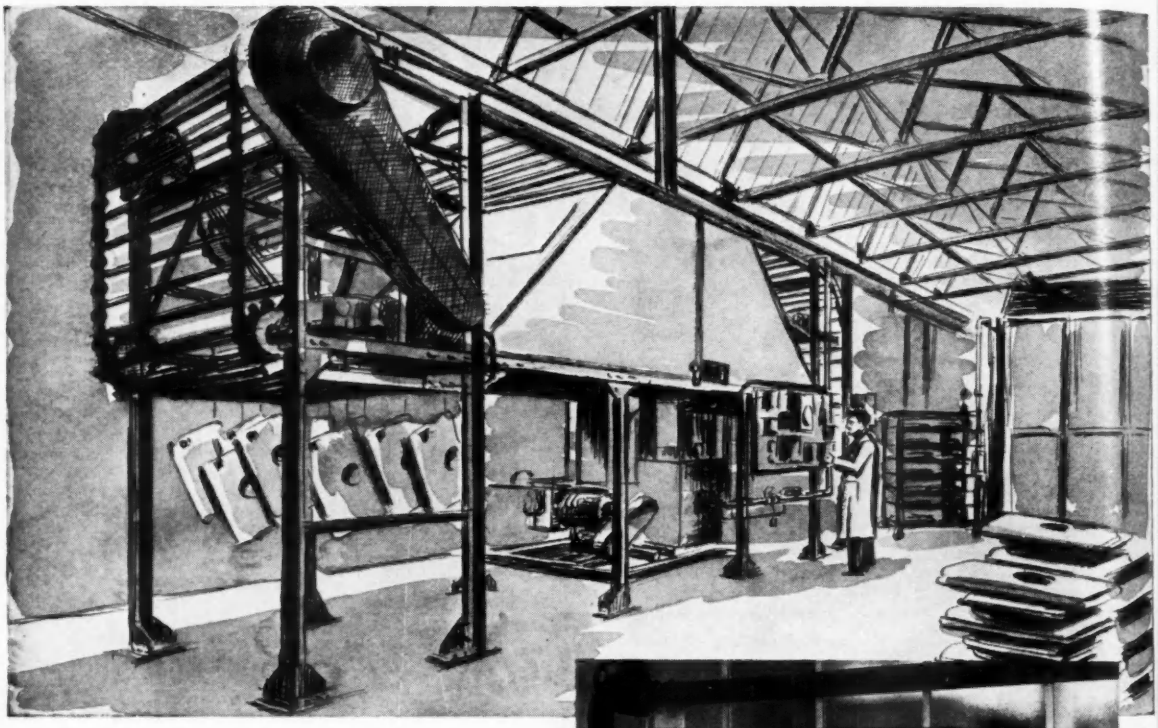

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Gas Journal

VOLUME 295. No. 4963 AUGUST 27, 1958. 110th YEAR

Demonstrations as a Sales Technique

IT is a good many years since well-informed people in the gas industry stopped calling home service advisers 'demonstrators,' a label which implied that these ladies' activities were limited to showing female audiences how to make this or that dish. Nevertheless, despite home calls, showroom duties, etc., demonstrating still constitutes an important part of a home service adviser's job. What has changed is the increased emphasis now placed on making definite sales points concerning the appliances used—and indeed concerning others which are not actually used during the demonstration. Properly handled this type of demonstration can be an extremely valuable adjunct to the sales machinery of a gas board.

In the July issue of 'GAS SERVICE' we devoted our main editorial to an analysis of an unsuccessful demonstration which we had recently seen performed by an electricity board home service adviser. There the matter might have rested had not *Home Economics*, a journal wielding considerable influence in the field, reproduced our leader in full and contributed some comments of its own. In view of this and of other evidence of interest we felt that a few words on the subject might not come amiss in the 'JOURNAL.'

Our leader began by pointing out that we had for a long time championed home service in the gas industry, particularly when it was utilised as a tool of the selling organisation. 'We do not dismiss ordinary demonstrations as a waste of time, although we recognise that there is a limit to the usefulness of those which do not ensure a constant change of audience. We think that in the hands of competent and sympathetic women, home calls can constitute a service of great value in ensuring consumer satisfaction. When home service advisers are properly trained in selling the appliances which they demonstrate, we regard them as among the most vital assets in the industry's possession. *But* in all this the operative phrase is "properly trained." Unless the home service advisers know exactly what they are doing and why they are doing it they are no more than the expensive ornaments they were supposed to be in the bad old days. Even today we sometimes hear murmurs of criticism and scorn about the activities of "les girls," and when this happens it is a pretty safe bet that the fault lies with sales managers who are too ignorant (or too frightened?) to ensure that these members of their staffs operate as effective links in the chain of sales promotion. Without that important training they *can* be a good deal worse than ornaments—they can be an absolute menace.'

We then went on to describe the electricity board demonstration to which we have referred and in which everything went wrong. The demonstrator—Miss X as we called her—had a brand new appliance on which the thermostat was wrong and which reduced her carefully prepared plan to ashes; she lacked a proper demonstration kit; time-wasting operations without accompanying patter allowed the audience's attention to wander; no recipes or leaflets were available; and tactless remarks impaired the reputation of the fuel used.

Finally, we examined some of the points raised in this post mortem: 'In the first place the demonstrator in question did not know her job, but the bulk of criticism must fall on her superior officers. They should not have sent out a girl who had not proved herself capable of carrying out an effective demonstration. They should have ensured that a tested appliance was used, that a proper demonstration kit was available, and that printed or duplicated recipe sheets and appliance leaflets were in stock. Most important of all, they should have trained the demonstrator in how to bring out the essential sales points of the electric cooker and, indeed, of other electric appliances, even though they were not used in the demonstration; above all, they should have ensured that the audience would be left in no doubt that electricity was the cheapest, cleanest and most efficient fuel available.'

And we went on to explain that we had told this cautionary tale not because it concerned electricity, but because it *might* have concerned gas. We asked: 'Do gas boards ever send out demonstrators with a similar lack of concern for their abilities and facilities?' This is where *Home Economics* came in. Having paid us the compliment of describing the editorial as 'wickedly

observant and a true story' and 'GAS SERVICE' as 'a trade paper that is as lively as it is well informed,' the editors answered our question as follows: 'We would say that it is most unlikely. We would also have thought it was pretty unlikely in the case of an electricity board. But, we are going to say here and now that members of the gas and electricity boards who read this article may not know what we know—that it *could* happen more easily in an electricity board, because electricity boards are not nearly so insistent on "proper" training for all their demonstrators.'

That is certainly nice to know, particularly as it comes from an extremely well-informed source, but although we know that the gas industry takes pains to see that its home service advisers have received the necessary training in domestic science we are not yet convinced that sufficient care is being given to training in selling. Only last week we saw a gas board demonstration which from the point of view of the audience was first class—informative, entertaining, and charmingly presented—but which made one think twice afterwards in order to remember whether it was a gas or an electric cooker which had been used.

G.W.F. Attains its Centenary

THE celebration of a centenary is always a signal for congratulations especially when it has been attained by a periodical serving a similar public to our own. This year *Gas und Wasserfach*, familiar to many in the gas and water industries as *G.W.F.*, celebrates its hundredth year of publication. It is the oldest German technical journal serving the gas and water industries and it might be of interest to recall that the 'GAS JOURNAL,' under its old name of the 'JOURNAL OF GAS LIGHTING' also catered for the water supply industry as well as the gas industry. The scope of the gas industry increased so rapidly, however, that it became necessary to confine the two interests with the result that *G.W.F.* published separate issues for its gas and water readers.

It is significant that a journal of this kind should have been founded on the Continent in the '50's of the last century, since it must have coincided with the demand for a more scientific basis for the industry abroad as in England. It would seem that industry generally had entered a new era and although competition was intense and likely to remain so for many years to come, the application of knowledge to the improvement of industrial methods as opposed to the traditional rule of thumb and progress by accidental discovery was evolving. There would, therefore, be a demand for a means of spreading what knowledge there was available. A good technical journal, which could be trusted to give an accurate account of what engineers were doing would be needed. Manufacturers of gas plant would also welcome some means of advertising their products.

In an editorial in the centenary number of *G.W.F.* the writer sets forth its aims, among which is that it 'seeks to publicise technical knowledge, scientific and economic progress, and to improve the status of the gas supply industry at home and abroad.' To do so *G.W.F.* with its reputation in the German gas industry for accurate reporting, is able to call on engineers of rank and repute for contributions on subjects dealing with the science and technique of gas production and distribution as well as those in allied fields in which the industry may only be indirectly interested.

The editorial goes on 'our technical journal . . . seeks to avoid becoming a "graveyard of knowledge" but rather to forge a link between science and practice.' After a reference to the falling behind of ethical and intellectual perfection compared to economic and material welfare, it continues 'the goal of *G.W.F.* is to serve mankind within the self-imposed discipline of technical responsibility in the knowledge that that can only be done if it is related to, and remains within, the greater whole.'

Thermal Insulation of Industrial Buildings

THE Minister of Power has now made regulations under the Thermal Insulation (Industrial Buildings) Act, 1957, prescribing a standard of insulation against the loss of heat from the roofs of new industrial buildings or extensions begun on or after January 1, 1959. Some classes of buildings are exempted.

The standard of insulation has been chosen as that which, over industry as a whole, will secure worth-while fuel savings at reasonable cost. It can readily be achieved using materials and constructions widely available. In the case of most new industrial buildings it is now generally accepted that the additional cost of insulation is offset in three or four ways by the savings in fuel costs alone, and on these grounds it may well be more profitable in some buildings to aim at a better standard of insulation than that prescribed.

The Regulations—'The Thermal Insulation (Industrial Buildings) Regulations, 1958' (S.I. No. 1220/1958)—also specify the kinds of materials which, if used to a substantial extent to achieve the standard of insulation, must either conform to a prescribed standard of resistance to the spread of flame or be used in such a way that they do not add to the risk of fire. An explanatory memorandum for the technical guidance of those concerned in the administration and operation of the Act and regulations is being made available by H.M. Stationery Office.

F.C.E.C. Handbook

THE 1958-59 edition of the Federation of Civil Engineering Contractors' *Handbook* is now available, 5,000 copies having been printed. The *Handbook* brings together in convenient and up-to-date form all the main Federation documents, including the working rule agreement of the Civil Engineering Construction Conciliation Board, the I.C.E. conditions of contract and the Federation dayworks schedules. It also contains an up-to-date list of the 680 members of the Federation. Copies of the F.C.E.C. Handbook 1958-59 may be obtained, price 12s. 6d. including postage and packing, from the Federation of Civil Engineering Contractors at Romney House, Tufton Street, Westminster, S.W.1.

CORRESPONDENCE

But What About a Good Employer?

DEAR SIR,

I feel I must reply to your special correspondent's article 'What is a Good Employee?'

I certainly found it 'thought provoking'—but not I fancy in the way he intended. Quite frankly I thought it a somewhat naive statement, more like a series of Moral Maxims rather than an original contribution to the subject of employee relations.

What I found most perturbing in the article was the complacency it implied in the management attitude.

Some of the 'arguments' advanced were debatable to say the least, for example 'After all the manager is only the head of a team and can do next to nothing if the members of that team are dull and apathetic or indifferent.'

From experience I know that if personnel are dull, apathetic and indifferent it is almost certainly because of uninspired and ineffective management leadership.

Your correspondent says of the American employee that he 'realises that every industrial concern must be always dynamic and never static.' Why is the American employee attitude so different (apparently) from the British employee's? The answer is inescapable—because the American employer's attitude *is* different.

Among your correspondent's references to the 'good employee' is the following: 'He will be eager to show his adaptability and to prove that he, too, is dynamic and enamoured of an adventurous attitude towards his employment and his own capabilities.'

Parsimonious

Again judging from my own experience I should reply briefly: 'He would if he could but in too many cases he can't.' Why? 1. Only rarely does management show a genuine interest in the talents and capabilities of individual employees. 2. When an original suggestion is submitted and accepted, the 'reward' is usually of such a parsimonious nature as to make the recipient hostile to the suggestions scheme ever after. 3. The pigeon hole type of grading structure in nationalised industry mitigates greatly against individual enterprise. 'You stay in your own wee corner and don't trespass' appears to be the attitude. I see little evidence of management interest in the application of job evaluation.

If executives in the gas industry are really anxious to find out about employee initiative and 'adventurousness' I can suggest a simple experiment. Let them conscientiously perform the duties of a B or C grade clerk for a period of six months. I should be intrigued to know whether at the end of their stint they still felt 'dynamic' and 'enamoured of an adventurous attitude' towards their employment.

My experience leads me to believe that employees in the gas industry are always willing and anxious to show what they can do—under the right sort of leadership. Very often apathy, indifference and resentment are directly traceable to administrative deficiencies such as bad liaison between departments and chief executives, indecisiveness, lack of a definite employee relations policy and especially, bad communications between management and personnel.

In the technical field the gas industry is probably as adventurous and progressive as any. Can we honestly say that in the effective adoption of enlightened management techniques we are equally progressive? Merely indicating such developments as, for example, the introduction of functional control does not answer the question. The erection of new administrative structures does not of itself imply an enlightened management approach. What matters is the effectiveness of these new structures from the individual employee's point of view. It is here, I feel, that 'management' in the real sense has deteriorated. Why has this happened?

Primarily, I should say, through complacency and a too conservative approach. Units have become big (too big?), but top administrative thinking has not been proportionately big enough.

Deteriorated

In the gas industry it is vital that we enourage initiative and original thinking at all levels for the simple reason that the administrative structures which have been evolved are still largely 'experimental.' Time alone will tell whether they are the most effective structures or whether they should be modified in the interests (say) of better employee or consumer relations.

In a truly 'enlightened' and progressive industry, the interests of management and workers do not clash but coincide. It is then rather pointless for either side to strike attitudes: 'I'm the Boss. I know my responsibilities. You do as I tell you or else!' or 'I'm a Worker. I know my rights. You can't browbeat me. I'll see my Union about this!'

I feel we should place much greater emphasis on the following:—

1. Communications. It is vital for good employee relations that there be an adequate flow of information from management to personnel—and vice versa. Employees have a right to know what's going on in the industry—at all levels. Likewise, management should take an interest in news concerning their own personnel and the views and ideas of personnel.

2. Employee relations. There should be a definite employee relations policy not a haphazard reliance on joint consultative committee meetings and other routine (and emergency) 'get togethers.'

3. Job evaluation. I think the whole promotional and grading structure of the industry should be critically examined. The transfer of employees with special talents should be sympathetically considered. Certainly, managements ought to be greatly concerned about the wastage of employee talents and not simply accept this as inevitable under the existing system.

Yours faithfully,
NOR'EASTER.

Scotland.
August 23, 1958.

Personal

MR. DAVID LEWIS has been appointed Midlands Junior Representative for the Gas Division of Parkinson Cowan Appliances. Mr. Lewis will be joining MR. ERNEST HUGHES, P.C.A. (Gas Division) East and West Midlands Area Manager, in the field in early October. His appointment follows the promotion, earlier this year, of MR. KEN LEECH to Representative in the North Western Gas Board area.

MR. A. C. ROLFE, of Northwich, Cheshire, has been appointed Deputy Chairman of the North Western Gas Consultative Council in succession to MISS A. V. BAYNES.

MR. M. L. HARTLEY has been appointed London representative for Clayton, Son & Co., Ltd., of Leeds.

Diary

September 3.—WALES AND MON. JUNIORS (NORTH WALES SECTION): General Meeting.

September 3.—SCOTTISH GAS CONSULTATIVE COUNCIL: 26, Drumsheugh Gardens, Edinburgh. Meeting at 11.30 a.m.

September 4.—WALES AND MON. JUNIORS (SOUTH WALES SECTION): Porthcawl. Paper by Mr. T. O. Jones, Solicitor to the Wales Gas Board.

September 5.—SCOTTISH WESTERN JUNIORS: 9, George Square, Glasgow. Opening Meeting of new session. Presidential Address by Mr. G. B. Scott. 7 p.m.

September 12.—SCOTTISH ASSOCIATION OF GAS MANAGERS: Civic Theatre, Ayr. Annual General Meeting.

N.T.G.B. GIVES LONG SERVICE AWARDS TO 50 EMPLOYEES

WITH 2,000 years' service in one undertaking between them, 50 North Thames Gas Board employees received 40-year long service awards recently.

They chose their gifts from a list which included gold watches, clocks, canteens of cutlery, and national savings certificates. Their wives were present at the ceremony, and the presentations were made by the Board Chairman, Mr. Michael Milne-Watson.

The men's average age was 56½ years, and the majority of them had been in the gas industry since they left school at the age of 14. Nearly half of them had followed their fathers into the industry, and several had grandfathers, brothers, uncles, or sons who had worked for the same undertaking.

During a visit to the Linacre works of the Liverpool Group, the Chairman of the North Western Gas Board, Mr. D. P. Welman, opened a new first aid centre. Here, Mr. Welman sets out on the tour of the works, accompanied by the Deputy Chairman, Mr. W. Hodkinson, and the Linacre Station Engineer, Mr. J. H. Green, right.

Air Control Installation

THE whole of the Ordinary share capital of Air Control Installations, Ltd., has been acquired by Beyer Peacock & Co., Ltd., of Gorton, Manchester. Mr. F. D. Moul will shortly be retiring from his position as Chairman and Managing Director, but will continue to be associated with the Company in an advisory capacity, as Director and President of the Company.

The general policy of the Company will remain unchanged, and it will continue to manufacture its wide range of air treatment equipment as heretofore. The membership of the successful Beyer Peacock Engineering Group will greatly assist Air Control Installations, Ltd., in their continued expansion and the development of new air treatment products.

SWISS CUT CO RISKS

WHAT is claimed to be the first centre in the world for the decontamination of coal gas has come into being at Basle, Switzerland. The reduction of carbon monoxide content from 12% to approximately 1% cuts out almost any danger of accidents through coal gas poisoning.

The decontaminated gas is to cost rather more to the consumer; however, the extra cost is so negligible—equivalent to less than 1d. on a monthly consumption of between 30 and 70 cu. m.—that consumers are not expected to object. The project will be subsidised by an increase in the price of industrial gas.

Northern Ireland

Coleraine Gas Sales Drop

COLERAINE (Co. Londonderry) gas undertaking, during the period June 27 to July 25, manufactured 10,664,600 cu. ft. of gas, a decrease of 765,200 cu. ft. compared with the corresponding period last year.

Total gas made from April 1 to July 25 was 46,245,000 cu. ft. compared with 48,874,300 cu. ft. in the same period in 1957.

So far, however, coke sales show an increase—761 tons compared with 754 in the same period last year.

Scorched Earth ?

'Scorched into Success' was the heading of a paragraph by 'Blythe' (regular weekly columnist of the *Farmer and Stock-Breeder*) in a recent issue of this publication. It related to a ley which at the beginning of its third season was given a top dressing of 500 gal. per acre of gas liquor. A week later, observed the writer, it seemed to be scorched out—but it has since given more keep than any other ley on this good grassland farm.

Windows Slashed

Windows of North Eastern Gas Board premises in Prospect Street, Hull, were among many to be slashed during the night recently. Thousands of pounds worth of damage has been done.

The Building Centre

The last day for submitting entries for the R.I.B.A. and Building Centre Competition for Manufacturers' Trade and Technical Literature, 1958, is October 31. Enquiries should be sent to the Building Centre, 26, Store Street, London, W.C.1. Telephone, MUSeum 5400.

CHANGE OF ADDRESS

The new London address of the Bryan Donkin Co., Ltd., and British Furnaces, Ltd., as from August 25, will be: 25, Westminster Palace Gardens, Artillery Row, Westminster, S.W.1. The telephone number for both firms remains the same, Abbey 1096.

Provisional Approval

Halifax Corporation has received provisional approval for a proposed smokeless zone in the centre of Halifax. The decision is not likely to have effect before August next year.

Successful Team

The Southern Gas Board, Southampton Region, first-aid team was successful at the regional round of the Buxton Trophy competition and will compete at the finals on October 5.

Engineering Scholars

The names of 11 boys who have been awarded the first scholarships to be provided under the Civil Engineering Scholarship Trust have been announced. Worth on average nearly £400 per year each, these scholarships will enable the boys to commence a three or possibly four years' course for a civil engineering degree at university this autumn.

W-D TO REBUILD FULHAM WORKS PLANT FOR N.T.G.B.

AN order has been placed with Woodall-Duckham Construction Co. Ltd. by the North Thames Gas Board for the reconstruction of the 30-year-old continuous vertical retort house plant at Fulham works to a more modern installation.

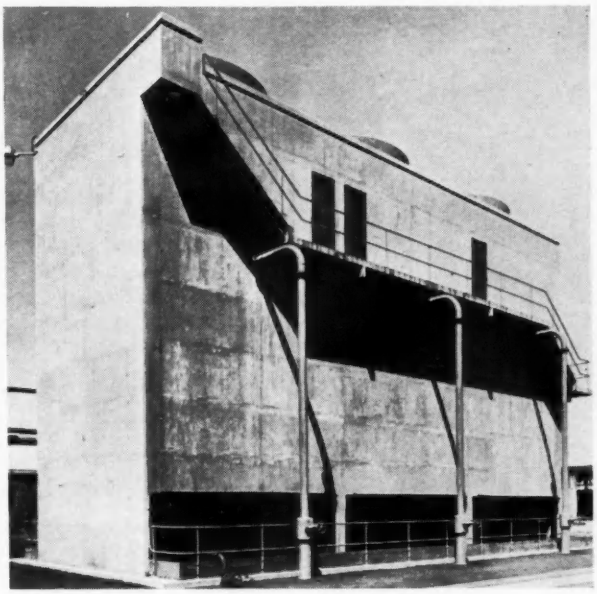
The present plant, which consists of two benches each of 36 103-in. downwardly heated retorts, is to be demolished to foundation level and two new benches each containing 36 82-in. W-D lambent-heated continuous vertical retorts with H. & G. mechanical producers will be built.

The total daily gas-making capacity will be over 7 mill. cu.ft. of 535 B.t.u. gas. New waste heat boilers are included in the installation, and aluminium sheeting will be used for cladding the retort house structure.

Shipley Clean Air

The order making a proposed smokeless zone in the Saltaire and Hirst Wood areas of Shipley, involving some 1,211 houses, is expected to be confirmed by next April and to come into force in about a year's time. Shipley Council is taking steps to inform the townspeople of the situation and of the reasons for this move.

THE WHITE LUND WATER COOLING TOWER



Pictured here is the water cooling tower at the new White Lund works of the N.W.G.B. Designed and installed by the Davenport Engineering Co. Ltd., of Bradford, its Superstructure, pond, and foundations are of reinforced concrete, while the internal packing, of timber construction, is arranged on the film flow principle and incorporates special features perfected by this Company. Total capacity of the tower is 60,000 gal. per hour, cooled through a range of 55°F. and to within 5°F. of atmospheric wet bulb temperature. Segregation is arranged within the tower which is divided into three distinct and separate compartments so that any one can be isolated for inspection without affecting operation of the others. Sufficient air for requisite performance is induced through the tower by a 12-ft.-diameter fan in a special chamber on the roof of each section. These are mounted on the output shafts of worm gear boxes driven through flexible shafts by 15 h.p. totally enclosed electric motors.

Nylon Aids Effluent Disposal and Water Conservation at Steel Works

THE successful use of nylon filters to help combat effluent disposal problems and effect conservation of water is reported from the Ebbw Vale iron and steel works of Richard Thomas & Baldwins, Ltd. These factors are of great importance at this works where 4,000 gal. of water per minute are used in the cleaning of blast furnace gases.

The used water, heavily charged with fine solid particles, is fed to settling ponds, known as Dorr thickeners, where these solids sink to the bottom and the relatively clean water is drawn off, cooled, and returned to the recirculation system. In the Dorr thickeners, rake arms propel the solids to the centre of the pond where they are pumped away in the form of sludge. It was this sludge which presented the greatest problem.

Under the original system it was discharged into a nearby river. But new pollution regulations will make this illegal and an alternative method of disposal had to be found. As an interim measure lagoons were used. At the same time expansion at the works meant increased demands for water, and as these could not be met easily by drawing more heavily on local supplies it was necessary to devise a means of using existing quantities more efficiently.

Filtration was decided on and a plant consisting of three disc filters was installed. This was the first of its kind in Britain and many difficulties were encountered before it operated efficiently. Among these was the problem of finding a suitable filtering medium. Various mediums were tried and eventually it was decided to use nylon.

Today the plant is the only one of its kind in Britain which is in full working order. By using only four discs on a single filter it is claimed to be possible to remove upwards of two tons of cake per hour with a moisture content of about 30%; on occasions the removal rate has reached four tons per hour.

Although the material is highly abrasive, consisting of more than 50% iron oxide, the nylon cloths have a life of between three and four months. The fabric used is a 12 oz. per sq. yard continuous filament twill.

Australian Firm Taken Over

THE whole of the share capital of Clive Skinner (Proprietary) Ltd., Melbourne, Australia, has been acquired by Bell's Asbestos and Engineering (Holdings), Ltd., for a consideration of A£43,763 in cash.

Clive Skinner (Proprietary), Ltd., is principally concerned in the manufacture of cast steel valves and the purpose of the acquisition is to extend the range of the Group's valve production in Australia, which is at present confined to non-ferrous valves.

New Holder

The West Midlands Gas Board is building a gasholder of 3 mill. cu.ft. capacity at Adderley Green, near Longton, Staffordshire. It will replace two smaller holders at Longton, and meet the increasing demand for gas in the southern part of Stoke-on-Trent.

Cork Gas Company

Interim dividend at the rate of 4% for the year ending December 31, 1958, has been declared by the Cork Gas Consumers' Company.

The Production and Disposal of Tar and Benzene By-Products in France

By

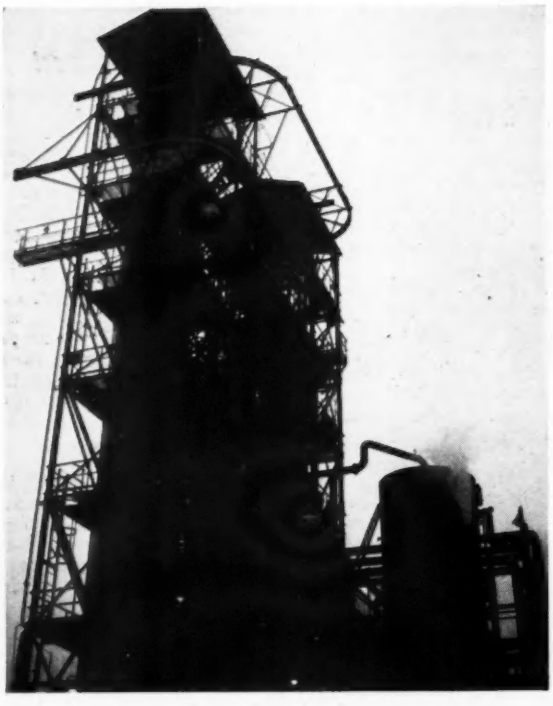
JOHN GRINDROD

ALREADY assuming an important place in the national economy, the by-products from the coal gas industry, blast furnaces, and coke oven plants in France—benzene, toluene, sulphur compounds, as well as tar and tar distillates—are expected to be produced to an even greater extent in the future.

For instance, whereas the French production of raw tar in 1938 was 520,000 tonnes (1 tonne = .98421 ton), this figure was increased to 637,500 tonnes in 1955 and is predicted to rise to 800,000 tonnes in 1965 and 970,000 tonnes by 1975. In 1957, the total French production of crude tar was in the region of 709,000 tonnes, which, together with 233,000 tonnes from the Saar, made a grand total of 942,000 tonnes. Of the total French production, about 230,000 tonnes, or rather more than one-third, is produced by the gas industry, represented by Gaz de France, and this has remained a fairly stable element of the annual production.

Of the total crude tar produced and in hand in 1957, 737,500 tonnes were distilled in France and 129,500 tonnes in the Saar. Crude tar used in its raw state amounted to 57,300 tonnes in France and 53,400 tonnes in the Saar. The distillation can be further broken down to 408,500 tonnes and 91,000 tonnes total distillation for France and the Saar respectively and 329,000 tonnes and 38,500 tonnes partial distillation respectively.

Products of the first stage of distillation included 217,200 tonnes of pitch, 261,400 tonnes of semi-distilled tar and 222,300 tonnes of crude oils for France and 51,900 tonnes of pitch, 30,000 tonnes of semi-distilled tar and 40,900 tonnes of crude oils for the Saar. Disposable production in 1,000's of tonnes of the various tar by-products in France and the Saar in 1957 were as shown in Table I:—



Tar distillation columns at the Cornillon plant of Gaz de France, near Paris.

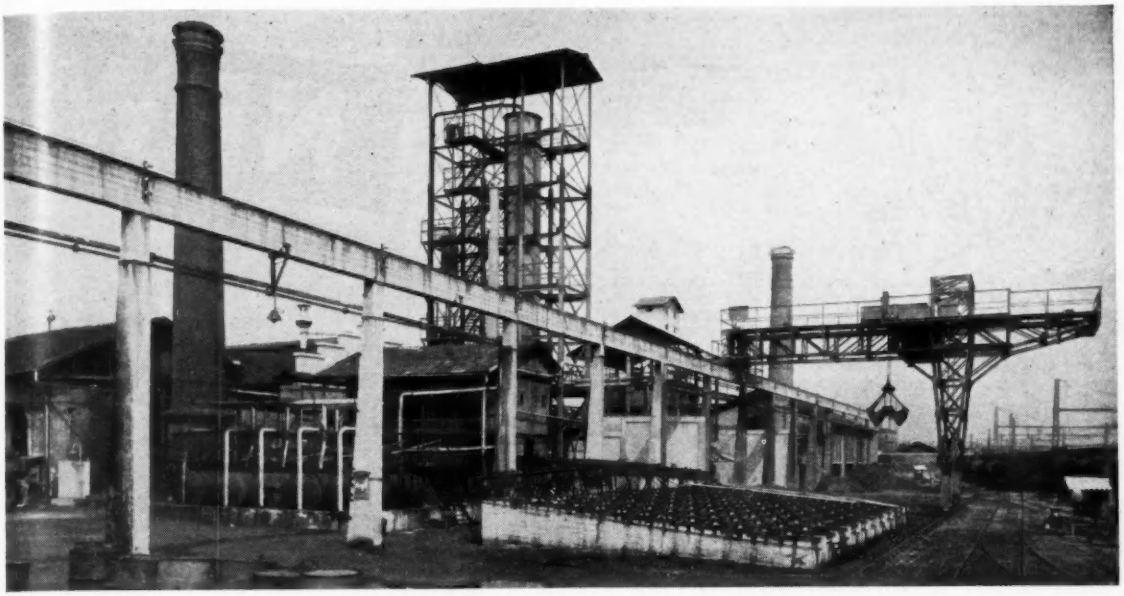
TABLE I.

Product	Crude production of intermediate products			Disposable production all products		
	France	Saar	Total	France	Saar	Total
Crude naphthalene	27·0	9·7	36·7	3·71	1·68	5·39
Naphthalene 78 deg.	19·4	6·4	25·8	13·47	6·43	19·90
Crude phenol	10·8	0·4	11·2	0·06	0·07	0·13
Prepared tar				299·57	42·84	342·41
Pitch				207·78	49·27	257·05
Oils				165·71	21·37	187·08
Pure napthalene				5·38	—	5·38
Pure phenol				3·16	0·15	3·31
Cresols: Tricresol				0·87	—	0·87
Cresols: metaparacresol				2·44	0·21	2·65
Cresols: orthocresol				1·14	0·02	1·16
Cresols: metacresol				0·14	—	0·14
Xylenols				2·33	0·01	2·34
Anthracenic deposits				0·64	0·66	1·30
Anthracene				1·28	1·31	2·59
Products returned to the tar				1·08	—	1·08
				708·76	124·02	832·78

Although the sale of about 710,000 tonnes of derivatives brought in a sum of about 11.2 milliards of francs, the theoretical percentages of product production were not attained in France, chiefly because of the still insufficient development of the secondary treatments. The benzene, naphthalene and phenol products represented only 6% to 7% of production, while the pitch, oils and prepared tar—'the black products'—constituted 93% to 94%. (The French milliard is 1,000 mill.; the rate of exchange is approximately 1,170 francs = £1.)

Outstanding Problem

That an adjustment of the heavy proportion of the tar derivatives passing through in the form of 'black products' is likely to be one of the outstanding problems to be tackled by the French coke and gas and distillation industries is substantiated by the fact that, whereas sales of the 7% represented by chemical products were responsible for 22% to 23% of the total receipts, the 93% of 'black products' brought in only 77% to 78%



General view of the tar distillation plant at Lyon-Saint-Fons.

of the total receipts. In the case of these latter products, prices are hard to maintain, competition is keen and the demand often slow, while in the first group, the reverse is generally the case.

Gaz de France distills only a part of its total crude tar production in its own factories. In 1956, only 125,150 tonnes of the 229,000 tonnes produced were treated in its Centre Autonome de Traitment des Goudrons et Benzols du Cornillon and at its factory at Lyon-Saint-Fons. The remainder was sold either to distillers or to industry for use in its crude state. Gaz de France increases or decreases distillation according to the demand from the different users of the distilled products. In 1956, the sale of raw tar brought in 878 mill. francs while distilled products sold for 1,632 mill. francs.

Production in tonnes in 1957 of benzene products in France and the Saar is shown in Table II:—

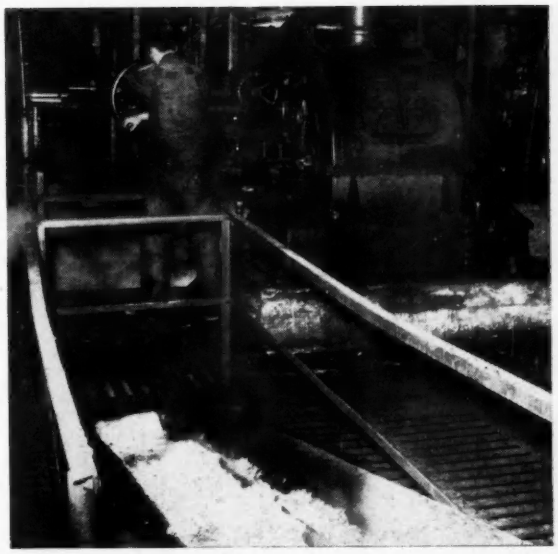
TABLE II.

Product	First stage production		
	France	Saar	Total
Benzoles	36,214	34,482	70,696
Toluols	10,216	1,706	11,922
Xylols	3,483	613	4,096
Solvent naphtha	2,352	82	2,434
Solvent 90/180	2,685	86	2,771
Various products	3,341	723	4,064
Sub-total of technical and chemical products	58,291	37,692	95,983
Benzene	60,469	18,054	78,523
Toluene	8,429	4,101	12,530
Xylene	2,440	1,005	3,445
Total	129,629	60,852	190,481

In addition, 3,298 tonnes of coumaronic and pyridic oils were extracted in France, providing 187 tonnes of coumarone solution, 1,538 tonnes of coumarone resin and 71 tonnes of pyridine. In 1957, there was no second stage treatment.

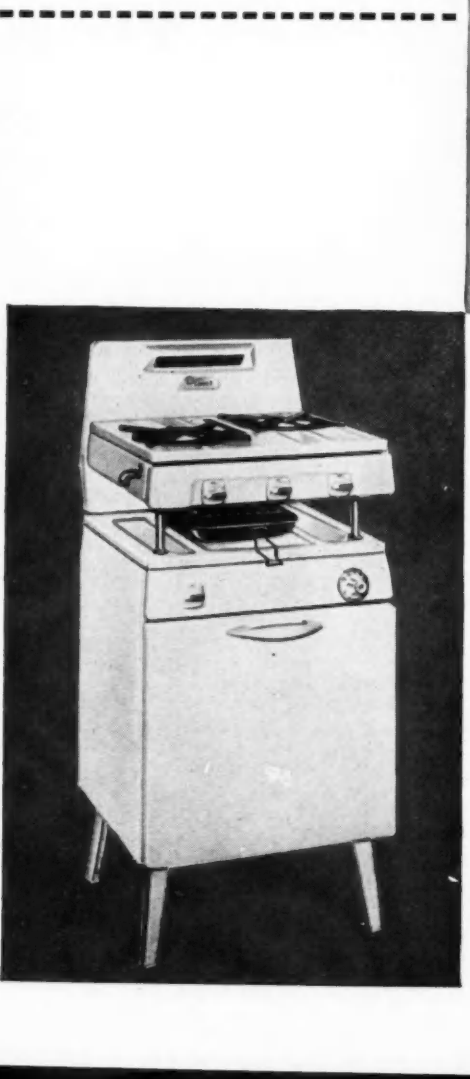
The part played by the gas industry in the production of benzenes is relatively small, varying from 8,000 tonnes to 15,000 tonnes according to the year. Out of a total of 23,900 tonnes of recovery sulphate of ammonia produced in 1956-57, Gaz de France produced only about 1,400 tonnes. This is actually less than was produced in 1950-51, but, on the other hand, production of 25% concentration of liquid ammonia has gone up. Heading the production centres of concentrated liquid ammonia plants of Gaz de France are the coking plants at Villeneuve-la-Garenne and Strasbourg and the gas plants at Nice and Nantes.

Crude benzole production of Gaz du France stands at about 10,000 tonnes a year but in the smaller gasworks



Naphthalene being delivered from the Lyon-Saint-Fons plant of Gaz de France by belt conveyor.

NEW leads



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it is uneconomical to recover this and it remains in the gas to improve its calorific value. At the same time, the gas industry itself is a consumer of benzole, and, since the natural gas purchased by Gaz de France in increasing quantities contains no benzole, it is estimated that this enterprise, which, at present, still sells a certain amount of benzole, might become a buyer of this commodity in a few years' time. Most of the Gaz de France benzole is produced in the Paris area, Lyon, Strasbourg, and Grand-Quevilly.

The overall French disposal of crude tar and tar products in 1,000's of tonnes in 1957 took the pattern shown in Table III.

Disposal of phenolic products, naphthalene, anthracenic deposits and anthracene in 1,000's of tonnes in 1957 was as shown in Table IV.

For the year 1957, disposal, stocks, export and import of benzene products in tonnes were as in Table V.

Compressed fuels in France are consumed to the tune of about 8 mill. tonnes a year, the 'boulets' or balls being popular in certain areas and the briquettes being used by the French railways and a number of industries. Generally, however, briquettes have lost much of their popularity. Including the Saar production, the compressed fuel factories use annually about 6.4 mill. tonnes of coal, 499,000 tonnes pitch and 28,000 tonnes of bitumen. The French tar distilleries are able to produce only about one-third of the needs in pitch for this purpose. The rest has to be imported.

Competition Feared

Although there would seem to be an opening here for the stepping-up of production, experts are uncertain of the future stability of the market and the strong competition of natural gas is feared in western France. On the other hand, it is also possible that bitumen, of which there is a surplus in France, may take the place of pitch in the manufacture of compressed fuels, as has happened in the United States.

Such reduced demands for pitch for compressed fuels might, however, be offset by the needs of certain type pitch in the electrical, electro-chemical and electro-metallurgical industries. For the manufacture of electrodes in France some 72,000 tonnes of petroleum coke and 40,000 tons of pitch coke have to be imported annually, the latter being obtained from about double the quantity of the pitch produced from the carbonisation of coal.

TABLE III.

Destination	Crude tar	Prepared tar	Pitch	Oils
In France				
Autoconsumption (including combustion)	48·41	16·58	4·59	34·85
Manufacture of boulets and briquettes by agglomeration	—	—	205·33	—
Electrodes	—	1·34	31·75	—
Road materials	4·05	278·37*	—	10·11
Debenzolage	—	—	—	9·27
Timber impregnation	—	—	—	46·29
Other uses	3·36	19·67	19·75	47·26‡
In the Saar	30·57	15·87	0·05	9·67
Export	24·30	2·92	2·13	22·52
	110·69	334·75	263·60	179·97

* As well as the French-produced 278,370 tonnes of road tar used, 47,720 tonnes were imported. ‡ Of which 15·62 was used for benzole rectification.

Increasing Demand

In addition, 20/30,000 tonnes of special types of pitch are used in the compression of the cokes to form electrodes. It is anticipated that both for the French aluminium industry and for developments at Lacq and in Africa pitch for electrodes will be in increasing demand. Even if the production of pitch cokes in France is uneconomic under existing conditions, the prices obtained for the special pitches are of interest to the French producers. The Gaz de France distillery at Saint-Fons is now supplying certain factories in the Alps and Pyrenées.

Road construction calls for three main types of binding agents—bitumen, tar and cement. Already, at about 830,000 tonnes a year, the use of bituminous products has more than tripled in France since 1938, and

TABLE IV.

	Anthracene and anthracene deposits	Phenolic Products				Naphthalene		
		Phenol products for re-treating	Pure phenol	Cresols	Xylenols	Crude	Compressed	Pure
Chemical Industry	2·46	—	3·0	4·40	2·24	0·99	9·31	3·49
Other uses	0·80	0·19	—	0·40	0·10	0·39	9·25	1·67
Export	0·47	—	—	0·11	—	4·91	1·14	0·10
Saar	—	0·36	0·01	0·09	0·06	0·16	—	0·01
	3·80	0·55	3·01	5·00	2·40	6·45	19·70	5·27

TABLE V.

	Benzols	Toluols	Xylols	Solvents	Benzene	Toluene	Xylene	Various products	Total
Carburisation	28·530	—	—	—	—	—	—	—	28·530
Industrial use	7·799	11·247	3·623	4·927	2·587	7·953	2·816	2·573	43·525
Chemical industry	—	—	—	—	68·144	4·408	675	—	73·227
Various	2·655	443	267	267	3	12	5	1·419	5·071
Saar	53	290	184	1	—	6	—	496	1·030
Export	10·927	—	—	—	6·670	—	—	97	17·694
Total	49·964	11·980	4·074	5·195	77·404	12·379	3·496	4·585	169·077
Stocks at the end of year	41·100	483	357	540	3·486	314	116	2·111	48·507
Imports—Customs figures	691	1·332	—	6·604	208	1·392	4·608	—	14·805

since the petroleum refineries are expected, in the near future, to be able to supply quantities in excess of the French demand for road construction, these products constitute a serious threat to tar, the use of which has remained fairly constant since the war at between about 300/350,000 tonnes a year, compared with 426,000 tonnes in 1938.

Prepared tar is, therefore, finding it difficult to maintain its place in this connection though strenuous efforts are being made to improve the position, and production should be increased in the coming years. Technically, it is claimed, tar can now satisfy all the needs associated with the construction and maintenance of roads, aerodrome runways and tracks.

Tar concretes can now be made of a compactness comparable with that of bituminous concretes. Furthermore, it is claimed that tar puts up a good resistance to the thrust of carburants and hot gases from jet engines on airfield strips. It can also be placed whatever the atmospheric conditions and provides a good non-skid surface.

Growing Market

At present, the use of cement in France is limited to the construction of those main arteries that bear very heavy traffic.

For combined bituminous and tar products, the market for road construction and maintenance continues to grow and in 1957 had reached about 1,160,000 tonnes. It is estimated that desirable new surfacings would require about 13/14 mill. tons of binding agents and that the normal upkeep of such a modernised system would involve each year the use of a further 1 mill. tonnes, or slightly more.

Large Users

The French railways are the largest users of creosote for wood preservation and it has been estimated that their needs amount to 20,000 tonnes (minimum), or 80,000 tonnes (maximum) a year, according to the method of impregnation adopted. The P.T.T. and the E.D.F. are also considerable users of creosote. As well as supplying French needs, Gaz de France exports some of its surplus production.

In spite of the difficulties being encountered in the marketing of certain of the tar and benzene by-products in France, Gaz de France point to the very considerable growth of demand for many of their products over recent years. They also forecast that, in 20 years' time, the demand for some products, such as ammonia, ethylene and methanol, for instance, will provide immense opportunities and that the outlook for demands from the plastics, rubber, paints, solvents and similar industries is none the less promising.

The writer is indebted to Gaz de France, who have also supplied data compiled by Syndicat Général des Industries des Goudrons et Benzols (SGIGIB), for material from which this article has been prepared.

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A Study of Hydrogen as Carrier in High-B.t.u. Oil-gas Production

By J. M. REID, B.Sc., Chem.Eng., W. G. BAIR, B.Sc., Chem.Eng., and H. R. LINDEN, B.Sc., Chem.Eng., Ph.D.,

SUPERVISOR, PROCESS ENGINEERING; SUPERVISOR, PILOT PLANT; AND RESEARCH DIRECTOR AT THE INSTITUTE OF GAS TECHNOLOGY, CHICAGO, ILLINOIS.

THE results of a study of the production of high-B.t.u. oil gas by cyclic thermal cracking of petroleum oils are presented. Experimental data were obtained using a four-shell, cyclic-regenerative pilot unit of improved design and with a nominal make (process) oil capacity of 50 gal. per hour. The improved design features include the use of clean regenerators instead of the conventional superheaters, elimination of hot valves and substitution of a dual, closed circulation product quench system for the conventional water-sealed wash box. These features reduced the deposition of coke and pitch, problems of handling by-products and smoke formation. In addition, the high-B.t.u. oil gas contained less inerts than that produced in conventional sets. Complete operating data were obtained at make (gasification) pressures up to 50 p.s.i.g., and at carrier gas hydrogen rates of up to 65 cu.ft. per gal. of make oil. Results indicate that the use of process hydrogen permits the production, from all types of oil, of gases of 1,000 B.t.u. per standard cubic foot, and of 0.6 to 0.7 specific gravity with combustion characteristics approaching those of natural gas. At make pressures up to 10 p.s.i.g., set capacities were increased by 20% for low-grade residual oils, and by more than 40% for premium oils. At 30 to 50 p.s.i.g. maximum make pressure, set capacities were not significantly increased by the use of hydrogen; with residual oils, substantial reductions in conversion to gas and excessive coke laydown were observed. However, after light oil removal, the make gases could be completely substituted for natural gas on critical appliance burners over most of the usual range of adjustments.

Major Problem

The increased availability of natural gas has been accompanied by a rise in heating value of distributed utility gas and an extension of space-heating service. Since long-distance transmission lines can be operated economically only near their design capacity, the supply of high-B.t.u. peak load gas has become a major problem.[24, 32] In areas where facilities for underground storage do not exist, the most widely used method for producing peak load gas consists of mixing vaporised propane or butane with air; however, the high cost of conventional pressure tank storage, and the limited availability of liquefied petroleum gases during the winter months have made it necessary to rely on processes utilising distillate and residual petroleum oils for a large portion of supplementary gas production.

Chief Operating Factor

The conventional method for producing high-B.t.u. gas from liquid fuels is high-temperature thermal cracking. The influence of feedstock properties and operating conditions (reaction time, cracking temperature, pressure and dilution with inert or reactive carrier gases), on gaseous and non-gaseous product yields and compositions has been studied extensively.[13, 17, 18, 25] The chief operating factor which determines the process economics is the rapid decrease of the conversion of oil to gas, and the corresponding increase of non-gaseous products, which accompanies an increase in the carbon: hydrogen weight ratio of the feedstock. Yields of high-B.t.u. oil gas range from 60% by weight for distillate oils, to less than 40 for the lower-grade residual oils. The remainder of the oil is converted to low molecular weight aromatic products (light oil), tar and deposited carbon. The weight per cent. gas yield is directly related to the recovery of the heat of combustion of the feedstock in the form of stable gas (B.t.u. recovery) which, together with the liquid by-product credits, to a large extent determines the value of a given feedstock.

Gas composition is not significantly affected by feedstock properties under constant cracking conditions since the mechanism of the vapour-phase reactions forming the gaseous products remains the same after the primary cracking reactions—that is, those reactions specific to the feed hydrocarbon—have been completed.[13] Gas composition is, however, quite sensitive to the severity of cracking. At atmospheric pressure, and over the usual 1,400° to 1,550°F. average cracking temperature and 1 to 5 second reaction time range employed in high-B.t.u. oil gas production, gas compositions will vary from 35 to 45 mole per cent. methane, 2 to 7 mole per cent. ethane and higher paraffins, 20 to 30 mole per cent. ethylene, 2 to 15 mole per cent. propylene and higher olefins and diolefins, 15 to 30 mole per cent.

hydrogen and, depending on condensing conditions, up to 5 mole per cent. low molecular weight aromatic products. With 1 to 2 mole per cent. of aromatic products, these compositions correspond to a heating value range of 1,000 to 1,400 B.t.u. per cu.ft.

The composition of the non-gaseous cracking products depends on feedstock properties as well as on the severity of cracking since the high molecular weight condensed-ring hydrocarbons which are found in the higher-boiling fractions of petroleum oils do not crack in the vapour phase but form aromatic products of high molecular weight (tar and pitch) and coke directly by dehydrogenation, cyclisation and polymerisation. Minimum coke or carbon formation is approximately equal to the Conradson carbon residue value of the feedstock.[17]

Cyclic thermal cracking of distillate and residual oils in an atmosphere of steam at almost atmospheric pressures is the only process now used commercially to produce high-B.t.u. gas from these feedstocks. This situation exists because most manufactured gas companies that changed over to natural gas distribution already had available carburetted-water-gas installations which could at moderate cost be converted to produce 1,000 B.t.u. per cu.ft. gas from petroleum feedstocks. This conversion resulted in a substantial increase in the thermal capacity of the set, and in a simpler operation through elimination of solid-fuel handling. The history of the development of the various processes for producing high-B.t.u. oil gas has been reviewed by Morgan.[22]

All the modifications of processes involve the contact of oil, dispersed in carrier steam, with checkerbrick maintained at a temperature of 1,300° to 2,000°F. by periodic reheating. Deposited carbon is burnt off during the air blast period of the operating cycle, supplying part of the heat required for the process. The remainder of the heat required is supplied by the combustion of heat oil. If regenerative heating of the blast air and steam is used, the thermal efficiency of the process may be as high as 85% (including the heat of combustion of liquid by-products).

Operating Problems

In the present stage of development of the cyclic high-B.t.u. oil gas process, the production of gases completely substitutable for natural gas is not practical.[29, 30] A number of operating problems interfere with selection of cracking conditions to ensure optimum gas quality,[5, 9, 34] particularly when residual oils with high carbon-forming tendency are used as a feedstock. These include:

(*a*) Incomplete combustion at the beginning of the blast period, which produces smoke. The initial blast gas has thus to be discharged into the make gas recovery system to prevent atmospheric pollution, rather than through the stacks. This practice produces an oil gas of increased inert content which makes it less suitable for use as natural gas.

(*b*) With the severe cracking required to obtain optimum gas quality, gas offtakes and valves which convey hot products of cracking to the recovery system have a greater tendency to become blocked with pitch and coke. Further, the wash box (the water-sealed product quench) tends to become fouled with pitch, and is the source of stable tar-water emulsions.

Continuous thermal cracking processes employing fluid or moving pebble beds of heat transfer medium have been developed to a pilot-plant scale in an effort to overcome some of the basic disadvantages of cyclic processes.[4, 20, 27] However, investment costs of these processes are only competitive for new installations of large capacity (20 mill. cu.ft. per day and over). Conversion of existing carburetted-water-gas plants to high-B.t.u. oil gas operation, and increase of the capacity of converted plants, are considerably less costly than new plant construction.[3, 10] These factors will probably also delay acceptance of the continuous pressure hydrogenolysis processes now under development.[6, 14, 31]

Laboratory Studies

In an effort to overcome some of the difficulties encountered in current high-B.t.u. oil gas operations, laboratory tube furnace studies were conducted to obtain information on the effects of changes in conventional operation conditions on oil gas substitutability for natural gas, and on the yields and compositions of cracking products.[15, 23, 28] In the course of these studies it was found that in the range of cracking temperatures and residence times employed in commercial sets:

(*a*) Thermal cracking of oils under moderate pressures (30 to 60 p.s.i.g.) produced oil gases almost completely substitutable for natural gases because of increased paraffin concentrations and decreased olefin concentrations. However, this improvement in gas quality was accompanied by a decrease in gas yield and an increase in liquid products formation.

(*b*) The use of carrier gas hydrogen at a rate of approximtaely 60 cu.ft. per gal. oil* further reduced gaseous olefin production, and at the same time resulted in conversions of oil to gas approximately equal to those obtained without carrier gas hydrogen at atmospheric pressure. In addition, significant reduction in free carbon content further improved the quality of the tar.

(*c*) Low-severity thermal cracking of oils in the presence of hydrogen at atmospheric pressure resulted in the production of oil gases which were highly substitutable for natural gas and similar in composition to the gases obtained with severe cracking in the absence of carrier gas hydrogen. There was also a slight increase in conversion of oil to gas when hydrogen was used as a carrier gas at low pressure.

(*d*) The use of hydrogen carrier gas at low or moderate pressures resulted in increased volume of make gas for all types of feed oils, at least equivalent to the thermal input in the form of hydrogen.

Thus, it appeared that the use of hydrogen-rich carrier gas, in conjunction with modifications in set design and operating cycle to reduce blast gas dilution, accumulation of carbonaceous deposits and tar handling problems, would permit trouble-free production of natural gas substitutes from all types of petroleum oils.

Modifications of the Hall process[2, 8, 33] were developed in the present study (see Fig. 1) in which the cracking products are withdrawn and quenched immediately after leaving the cracking zone, and only clean gases and vapours (air, flue gas, steam and process hydrogen) are passed through the regenerators. A four-shell configura-

* Oil volumes are given in U.S. gallons, measured at 60°F.

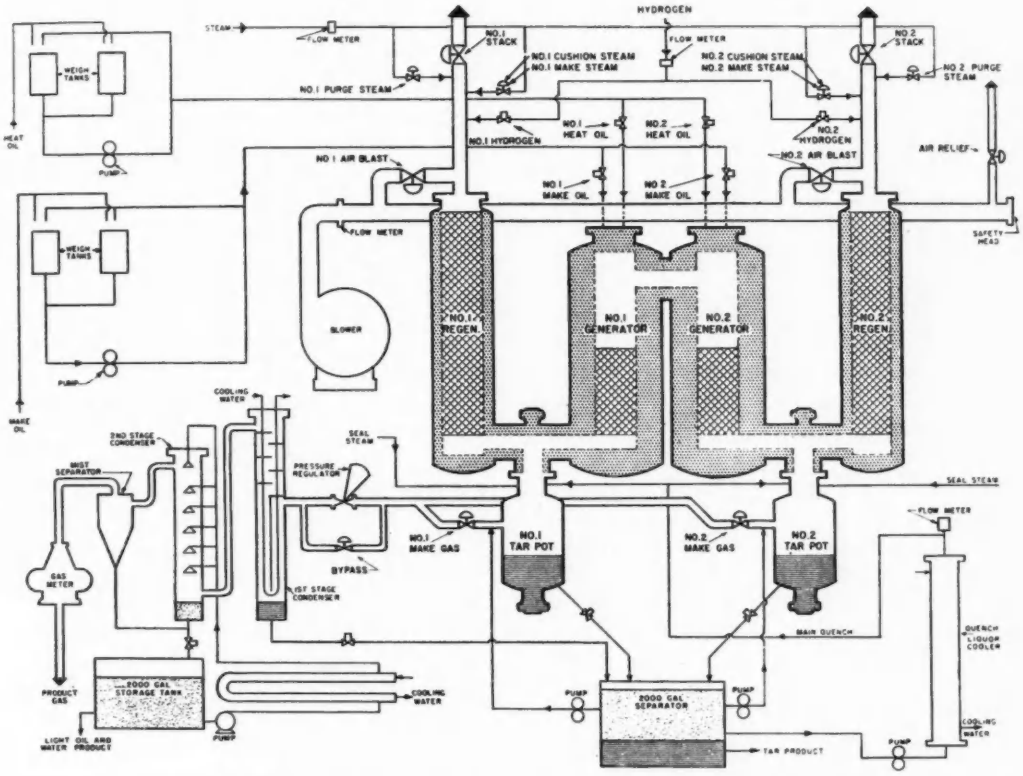


Fig. 1. Flow diagram of four-shell pilot unit for cyclic-regenerative high-B.t.u. oil gas production.

tion was selected as a basis for design of the pilot unit because it is more accessible than the two-shell inverted 'U' regenerative set design. To allow pressure operation, all shells were designed according to API-ASME pressure vessel specifications, taking into consideration cyclic conditions imposed by the process. Also, for safe operation at elevated pressures, and to reduce operating difficulties under all types of operating conditions, the use of hot valves was eliminated. This was accomplished by: (*a*) Very efficient regenerator design, reducing maximum stack temperatures to approximately 400°F. and (*b*) cooling of the product gas stream to below 400°F. before it passes through the reversing valves.

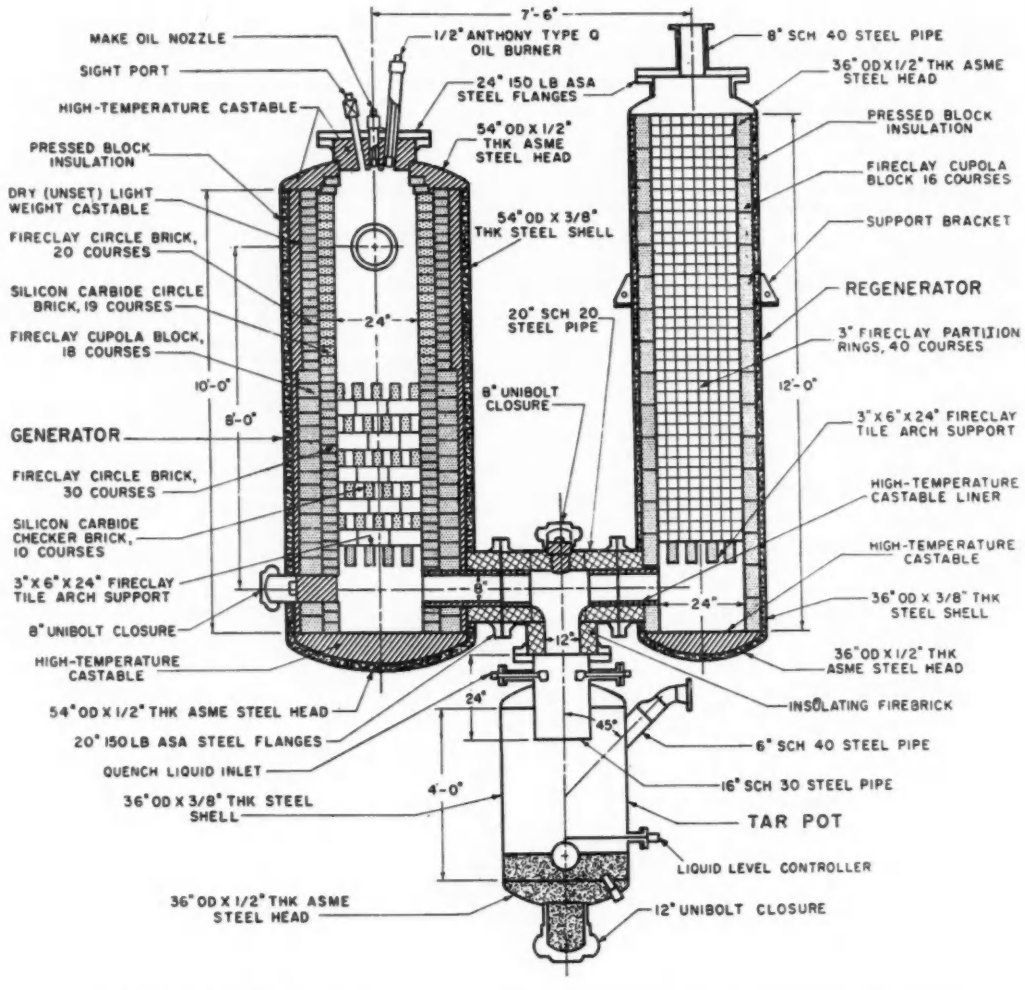
Internal diameters of the vessel were 2 ft., the minimum permitting ready access. The internal height (10 ft.) of the generators was determined by the reaction volume required for 50 gal. per hour nominal make oil feed rate on the basis of commercial practice. The internal height (12 ft.) of the regenerators was based on the heat removal characteristics of the regenerator checkers at maximum anticipated blast air rates and temperatures.[12] Details of set design are given in Fig. 2.

Elimination of coke, pitch and soot deposits on the regenerator checkerbrick permitted the use of tiles with smaller flue area and approximately five times the heat transfer surface per unit volume than standard 9-in. straight bricks stacked with 2½-in. spacing. The increased heat transfer rates gave higher air preheat temperatures, thereby accelerating the combustion of coke deposits in other parts of the set. Reduced smoke formation at the start of the blast permitted discharge of all of the blast gas through the stacks. As a result of lower dilution with blast gas, make gases with specific gravities approaching those of natural gas could be produced even from residual oils.

The need to provide for pressure operation, and the elimination of hot valves, made the conventional single water-sealed wash box design impractical. A closed dual offtake system suitable for pressure operation was employed instead. In this system, the cracking products were contact-quenched immediately upon leaving the refractory-lined, air-blasted zones of the unit. An indirectly-cooled recycle stream of the water-rich phase from the liquid products separator was used as the quench medium.

The product gas offtake in the crossover between the generator and regenerator provided a very short distance between the cracking zone and the point where the hot product stream is quenched to a temperature below that at which condensation and rapid polymerisation of the pitch and heavy tar constituents occur; further, no change in flow direction of the hot product stream was necessary after it left the air-blasted zone. This minimised the problems of offtake and plugging which are common to residual oil operation in most conventional apparatus with the exception of some modifications of the Pacific Coast oil gas process which also employ short, dual offtakes without hot valves.[1, 11]

No difficulties due to coke formation were experienced throughout the pilot unit operating programme in either the cracking zone or the product offtakes. Performance with heavy residual oils was especially good in this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1/2" ANTHONY TYPE Q OIL BURNER
8" SCH 40 STEEL PIPE
SIGHT PORT
24" 150 LB ASA STEEL FLANGES
36" OD X 1/2" THK ASME STEEL HEAD
HIGH-TEMPERATURE CASTABLE
54" OD X 1/2" THK ASME STEEL HEAD
PRESSED BLOCK INSULATION
PRESSED BLOCK INSULATION
FIRECLAY CUPOLA BLOCK 16 COURSES
DRY (UNSET) LIGHT WEIGHT CASTABLE
54" OD X 3/8" THK STEEL SHELL
SUPPORT BRACKET
FIRECLAY CIRCLE BRICK, 20 COURSES
REGENERATOR
SILICON CARBIDE CIRCLE BRICK, 19 COURSES
24"
20" SCH 20 STEEL PIPE
FIRECLAY CUPOLA BLOCK, 18 COURSES
3" FIRECLAY PARTITION RINGS, 40 COURSES
10'-0"
8'-0"
8" UNIBOLT CLOSURE
12'-0"
GENERATOR
3" X 6" X 24" FIRECLAY TILE ARCH SUPPORT
FIRECLAY CIRCLE BRICK, 30 COURSES
HIGH-TEMPERATURE CASTABLE LINER
SILICON CARBIDE CHECKER BRICK, 10 COURSES
HIGH-TEMPERATURE CASTABLE
3" X 6" X 24" FIRECLAY TILE ARCH SUPPORT
8"
24"
36" OD X 3/8" THK STEEL SHELL
8" UNIBOLT CLOSURE
12"
HIGH-TEMPERATURE CASTABLE
36" OD X 1/2" THK ASME STEEL HEAD
54" OD X 1/2" THK ASME STEEL HEAD
24"
INSULATING FIREBRICK
20" 150 LB ASA STEEL FLANGES
45°
6" SCH 40 STEEL PIPE
QUENCH LIQUID INLET
16" SCH 30 STEEL PIPE
4'-0"
36" OD X 3/8" THK STEEL SHELL
TAR POT
LIQUID LEVEL CONTROLLER
36" OD X 1/2" THK ASME STEEL HEAD
12" UNIBOLT CLOSURE

Fig. 2. Section showing generator, regenerator and product offtake construction.

respect. One 32-hour run was made with a feedstock of 17.7 weight per cent. Conradson carbon residue at low make pressure without using process hydrogen feed. It was not necessary to remove carbon accumulation by holding the blast, as is often necessary in conventional apparatus with high Conradson carbon residue oils. Likewise, there was no indication of plugging at the product offtakes.

The closed pressure quench system was also designed to decrease the operating problems normally associated with wash-box operation. The hot product stream from the offtake was spray-contacted with the cooled (150° to 200°F.) water-rich recycle from the liquid product separator. The recycle stream was maintained at a low surface tension by the addition of 0.05 weight per cent. of Amine 220,[16] and thoroughly wetted all cool surfaces. This prevented accumulation of pitch and heavy tar. Handling of liquid products was also made easier by: (*a*) Eliminating pockets in the system ahead of the separator where partial separation of liquid products and water can occur; (*b*) using a liquid stream of relatively high velocity, and (*c*) maintaining a water-rich condition. Attempts to use a tar-rich stream for product quenching were not successful because the viscosity increased rapidly with use.

Other improvements over conventional high-B.t.u. oil gas operation developed in this study were the result of operating techniques rather than design principles, and are discussed below.

Soundness of the original design of the pilot plant[19, 26] was demonstrated by two years of successful operation. Minor modifications developed during the course of operation were concerned chiefly with the closed quench and condensing systems. The experimental programme consisted of operation with a No. 2 fuel oil, two reduced crude oils and a No. 6 fuel oil, with and without process hydrogen carrier gas, and make pressures ranging up to 50 p.s.i.g. Typical operating results for each of these oils are shown in Table 1.

Most of the pilot unit operation was carried out with the basic cycle shown in Fig. 3. The cycle was approximately 8 minutes in length (4 minutes in each direction) and provided for a make period and a blast period separated by steam purges. In pressure operation, a pressure blowdown period was added at the end of each make.

TABLE 1.—GASIFICATION RESULTS FOR FOUR-SHELL CYCLIC-REGENERATIVE HIGH-B.T.U. OIL GAS PILOT UNIT

Run No.	7	38	39	16	18	32–C	40	33	37	35–A	35–B
Oil :											
Type	No. 2 fuel oil			Reduced crude oil Midcontinent			Aruba		No. 6 fuel oil		
°API	36·3–36·4			23·0–23·2			21·8		11·0–13·0		
Carbon/hydrogen weight ratio	6·65–6·67			6·99–7·02			7·08		8·32–8·57		
Conradson carbon residue, wt %	0			5·3–5·4			6·6		11·4–12·9		
Process feeds*:											
Make oil, gal. per hour	54·00	77·42	78·35	50·09	46·81	43·90	51·31	49·86	49·42	48·31	41·68
Process hydrogen, cu. ft. per gal.†	0·0	47·5	40·9	0·0	59·9	54·5	54·0	0·0	52·0	56·3	66·1
Heat oil, gal. per hour	10·53	12·55	9·62	8·55	8·52	1·79	8·02	6·06	5·75	4·92	0·0
Blast air, cu. ft. per hour	34,560	29,670	25,180	26,980	26,300	26,870	33,200	28,820	32,310	26,060	26,360
Make steam feed, lb. per hour	233	270	259	395	283	194	210	213	219	232	212
Operating conditions :											
Temperature, ° F :											
Average generator	1,657	1,659	1,571	1,530	1,490	1,391	1,551	1,575	1,539	1,504	1,406
No. 1 regenerator, top	457	230	226	373	338	283	200	237	224	308	292
bottom	1,835	1,600	1,531	1,447	1,453	1,458	1,349	1,482	1,355	1,458	1,323
No. 2 regenerator, top	388	348	278	360	—	309	241	299	303	297	288
bottom	1,772	1,598	1,481	1,364	1,348	1,336	1,333	1,378	1,388	1,348	1,427
Maximum make pressure, p.s.i.g.	7·0	9·0	29·5	6·0	7·0	40·0	9·0	5·0	6·7	15·5	39·5
Operating results :											
Product distribution, wt % :											
Gas	48·16	60·26	56·62	55·04	75·80	51·86	60·63	38·97	41·91	39·61	30·68
Liquid products**	46·02	39·74	40·73	41·04	23·44	30·25	34·30	55·27	51·50	51·61	50·26
Coke††	5·82	0·0	2·65	3·92	0·76	17·89	5·07	5·76	6·59	8·78	19·06
Make gas, cu. ft. per hour	3,984	8,385	7,432	4,336	6,268	4,040	5,450	3,534	4,535	4,395	3,147
B.t.u. recovery, net, thou'. B.t.u. per gal.***	79·08	93·43	85·19	95·15	123·17	81·61	99·06	74·49	73·05	67·73	48·91
B.t.u. recovery, gross, thou'. B.t.u. per gal.	79·08	107·91	97·81	95·15	144·89	98·07	116·05	74·49	89·12	84·73	69·02
Feed consumption :											
Make oil, gal. per mill. B.t.u., gross	12·65	9·27	10·22	10·51	6·90	10·20	8·62	13·42	11·22	11·80	14·49
gal. per mill. B.t.u., net	12·65	10·70	11·74	10·51	8·12	12·25	10·10	13·42	13·69	14·76	20·44
Heat oil, gal. per mill. B.t.u., gross	2·47	1·50	1·26	1·79	1·26	0·41	1·35	1·63	1·30	1·20	0·0
gal. per mill. B.t.u., net	2·47	1·70	1·44	1·79	1·48	0·50	1·58	1·63	1·59	1·50	0·0
Hydrogen (H_2) reacted, cu. ft. per gal.	—	16·4	10·1	—	8·4	20·1	15·5	—	11·4	17·4	30·0
Make gas properties :											
Composition, mole % :											
Hydrogen	23·3	34·3	29·9	20·2	29·5	31·0	33·5	21·7	40·8	38·2	37·7
Methane	43·3	29·0	36·0	36·9	29·2	35·3	22·2	35·8	20·8	27·8	33·2
Ethane	2·8	2·5	3·7	2·8	4·3	5·3	3·5	2·6	2·8	3·4	4·5
Propane and higher paraffins	0·1	0·0	0·1	0·1	0·1	0·3	0·3	0·1	0·5	0·1	0·4
Ethylene	18·0	22·7	17·2	22·3	20·1	12·9	20·0	20·7	16·3	16·4	11·5
Propylene	5·0	3·0	3·0	3·4	4·8	4·0	7·3	3·0	6·2	4·1	3·2
Butylenes and higher olefins	0·3	0·1	0·0	0·2	1·1	0·5	1·2	0·1	0·5	0·4	0·5
Acetylene and diolefins	1·5	1·7	0·8	1·3	1·9	0·6	2·5	1·3	2·1	1·3	0·9
Benzene	1·4	1·8	2·9	2·7	1·7	3·3	1·7	2·3	1·5	1·3	1·5
Toluene and higher aromatics	0·2	0·2	0·7	0·9	0·8	1·1	0·4	0·7	0·7	0·4	0·4
Carbon monoxide	1·3	1·0	1·9	0·2	0·0	3·1	4·5	7·0	0·5	0·0	0·1
Carbon dioxide	1·8	1·0	1·1	1·2	1·6	1·6	0·8	1·1	1·8	2·2	1·7
Nitrogen	1·0	2·7	2·7	7·8	4·9	1·0	2·1	3·6	5·5	4·4	4·4
Total	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0
Heating value, B.t.u. per cu. ft.	1,072	996	1,031	1,099	1,082	1,066	1,093	1,051	971	931	914
Specific gravity, air=1	0·659	0·611	0·648	0·741	0·696	0·673	0·696	0·717	0·630	0·593	0·573
Liquid product analyses††† :											
Specific gravity, 60° F/60° F	1·213	1·130	1·166	1·203	1·228	1·205	1·152	1·198	1·142	1·203	
Distillation, wt %, 0–200° C	0·0	6·1	2·6	4·4	1·8	0·5	8·4	1·1	8·9	2·3	
0–300° C	16·6	39·2	33·1	18·4	10·1	12·1	26·3	18·2	34·2	14·5	
300–355° C	19·6	16·1	11·9	14·0	12·9	14·6	16·5	13·2	13·5	10·2	
Pitch	63·5	44·7	53·6	65·8	75·5	71·6	55·8	68·4	51·8	74·2	
Free carbon, wt %	21·7	3·6	12·5	15·3	22·0	20·0	9·2	20·5	8·9	16·6	
Sulphonation index, ml/100 g tar :											
0–300° C distillate	1·7	0·0	0·0	0·8	0·0	1·1	0·8	0·9	0·1	0·0	
300–355° C distillate	1·2	0·1	0·0	0·1	0·0	1·1	0·1	1·2	0·1	0·0	
Pitch softening point, ° F	204	194	201	234	211	223	248	209	305	192	

* Length of total cycle 465–484 seconds (232–242 seconds in each direction), including 34–39 % make oil and hydrogen introduction, 9–17% make purge and depressurisation, 39–48% blast and 9–10% blast purge.

† 80·0–95·2 mole % purity.

** By difference.

†† Calculated from difference in carbon content of flue gas (CO plus CO_2) and carbon content of heat oil assuming 6 wt % hydrogen content of deposited coke.

*** Gross B.t.u. recovery less heat of combustion of process hydrogen feed per gallon of make oil.

††† Light fraction recovered from second stage condenser not included in analyses for Runs 7, 16, 18,32–C, 33 and 35–A, B.

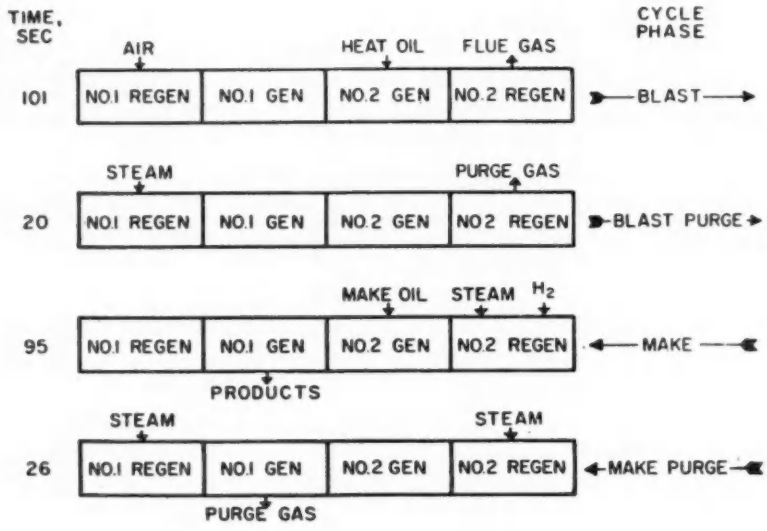

Fig. 3. Basic half-cycle used in pilot unit operation.

To define the maximum capacity of the pilot unit as a function of oil properties was not attempted. However, at make oil rates of the order of 80 gal. per hour for No. 2 fuel oil, and 50 gal. per hour for No. 6 fuel oil, the limit of satisfactory performance was apparently approached. Operation in a hydrogen atmosphere was characterised by the consumption of carrier gas hydrogen in the cracking process. This contrasts with the evolution of hydrogen under conventional thermal cracking conditions. At low pressures, the consumption of hydrogen was accompanied by increases in conversion of oil to gas and, except in the case of No. 6 fuel oil operation, by decreases in calculated coke laydown.

With No. 2 fuel oil, the increase in gross therms of gas produced per gallon of total (heat plus make) oil in the presence of hydrogen was approximately 40% at low pressure and 32% at 30 p.s.i.g. Since the reaction of hydrogen and hydrocarbons releases heat, the decrease in coke formation in a hydrogen atmosphere was not accompanied by an increase in heat oil requirements.

More Sensitive

The midcontinent reduced crude was less refractory and much more sensitive to make pressure than the distillate oil. This reduced crude was also found to be more highly reactive to hydrogen than the Aruba reduced crude. At 40 p.s.i.g. make pressure (Run 32-C), the weight per cent. of oil gasified was lower, and the calculated coke formation was considerably higher, than for conventional operation. Gas production from the mid-continent oil in terms of gross therms per gallon of total oil indicates that capacity of the set was increased through use of carrier gas hydrogen at low pressure and 40 p.s.i.g. make pressure, by approximately 51% and 16% respectively.

No. 6 fuel oil was affected by a hydrogen cracking atmosphere to a lesser degree than were the distillate and reduced crude oils. At low make pressure, the fraction of make oil converted to gas was only slightly greater with process hydrogen feed. At 15 p.s.i.g. make pressure, the weight per cent. oil gasified was about the same as for the conventional operation, whereas at 40 p.s.i.g. the conversion of oil to gas was lower, as with reduced crude. Unlike the other oils, No. 6 fuel oil showed no decrease in calculated coke formation in a hydrogen cracking atmosphere, even at low make pressure. Coke formation was also substantially higher at high pressure. The use of process hydrogen feed resulted in increases in set capacity, on the basis of gross therms of gas produced per gallon of total oil, of approximately 20%, 16% and 4%, at low pressure, 15 p.s.i.g. and 40 p.s.i.g. respectively.

With all the oils, properties of the liquid products were improved by the use of process hydrogen feed at low pressure. The paraffin content (sulphonation index) of the tar distillate decreased, and with No. 2 and No. 6 fuel oils, the free-carbon content was lower, and the percentage of low-boiling aromatic products was higher. For midcontinent reduced crude oil, although the quantity of free carbon produced was less with process hydrogen feed, the yield of liquid products was so low that the concentration of free carbon was higher. In most of the tests, the liquid products produced at moderate make pressuers (15 to 40 p.s.i.g.) with process hydrogen feed were of better quality than those produced at low pressure without hydrogen feed. At maximum make pressures in the order of 50 p.s.i.g., a tendency to produce tars with high sulphonation indexes was observed for reduced crude oil.

Although no detailed study was made of the effect of checkerbrick quantity and arrangement, several methods of generator checkering were used during the course of the pilot-plant programme. Initially, only three courses of standard 9-in. straight fire clay checkers were used; these were stacked with 2½-in. spacing and straight-through flues. This arrangement gave very non-uniform temperatures in the generators, and a high sulphonation index and free carbon content of the tar. (Run 7, Table 1, is an example.)

The first attempt at elevated pressure operation was not successful, partially because of an increase in non-uniformity of temperature which caused very severe

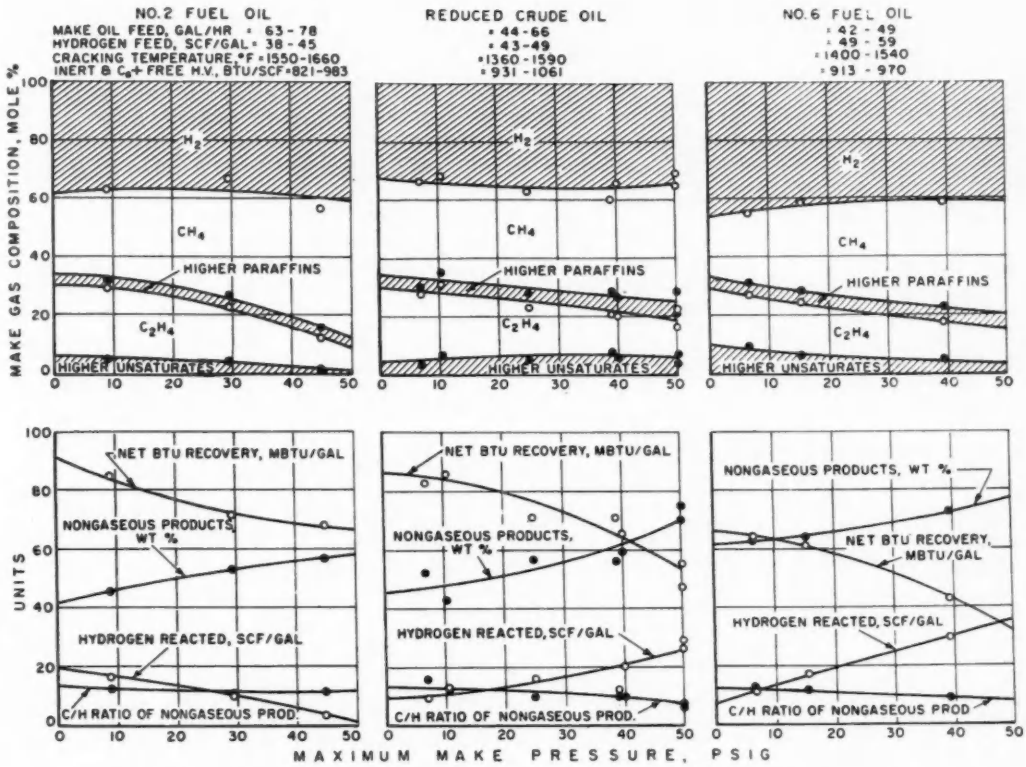

FIG. 4.—*Effect of maximum make pressure on cyclic hydrogasification results.*

temperature extremes between the beginning and end of the make period. The stacking of the generator checkers was changed from flued to stagged, while the 2½ in. spacing was maintained. Although considerable improvement was observed in temperature extremes, sulphonation indexes and free carbon contents of the tars produced remained high. Before the runs at elevated pressure shown in Table 1, the generator checkering was modified by replacing the three courses of fireclay brick with ten courses of standard 9-in. straight silicon carbide brick in 2½-in. staggered spacing. This significantly increased the effective heat storage capacity of the generators and resulted in more uniform temperature conditions over the make period. Improved operation was indicated by reduction in the sulphonation index of the tar and better control of free carbon content. It was also observed that the regenerator bottom temperatures were lower at corresponding generator temperatures with the ten courses of silicon carbide checkers. This checkering arrangement was deemed satisfactory and retained through the remainder of the operating programme.

Wide variations of process hydrogen feed rate were impractical, because the hydrogen:oil feed ratio is limited by the amount of hydrogen which can be utilised in hydrogenation reactions; excessive hydrogen breakthrough results in make gas dilution and an undesirable drop in make gas heating value. Thus, in the production of gas in the 1,000 B.t.u. per cu.ft. range at the make oil capacity of the set, maximum make pressure and, to a lesser extent, average cracking temperature were the main process variables. In practice, the maximum make pressure was set by automatic control devices, and the cracking temperature regulated to give a make gas of desired heating value. In Fig. 4, graphs are presented which illustrate the effect of maximum make pressure on hydrogasification results in production of high-B.t.u. oil gas of relatively constant heating value. The data are presented on the basis of make gas free of C_6 and higher hydrocarbons, since the concentrations of these normally liquid components are dependent on condensing conditions and sampling procedures rather than on process variables.

Decrease in B.t.u. Recovery

It can be seen from Fig. 4 that for all three oils used there was a consistent increase in gaseous paraffin concentrations, and a decrease in gaseous olefin concentrations, with increases in pressure over the 5 to 50 p.s.i.g. range, accompanied by a decrease in net B.t.u. recovery and an increase in non-gaseous product yields. This corresponds closely to tube furnace results obtained in preceding studies,[15] and in tests with the oils used in the pilot-plant programme (see Table 2). However, the decrease in net B.t.u. recovery, which is equivalent to a decrease in conversion of oil to gaseous products, was considerably greater in cyclic cracking of residual oils (compare Runs T—1 and 25, and Runs T—5 and 35—B, Table 2). The large decrease in net B.t.u. recovery from residual oils with increases in maximum make pressure was accompanied by a greater

TABLE 2.—COMPARISON OF LABORATORY TUBE FURNACE AND CYCLIC-REGENERATIVE PILOT UNIT GASIFICATION RESULTS

Oil type	No. 2 fuel oil		Reduced crude oil						No. 6 fuel oil			
Run No.	T-6	38	T-2	31-B	T-1	25	T-3	33	T-4	37	T-5	35-B
Unit (T=Tube furnace, P=Pilot unit)	T	P	T	P	T	P	T	P	T	P	T	P
Oil properties :												
° API	36·3	36·3	23·2	23·2	23·2	23·2	13·0	13·0	13·0	11·0	13·0	12·1
Carbon/hydrogen weight ratio	6·67	6·67	7·02	7·02	7·02	7·02	8·32	8·32	8·32	8·57	8·32	8·37
H_2 feed, cu. ft. gal.	45·6	45·2	48·7	42·8	42·2	47·8	0	0	41·7	48·9	45·5	58·5
Maximum make pressure, atm abs	1·01	1·60	1·02	1·45	4·38	4·39	1·03	1·32	1·02	1·44	4·26	3·67
p.s.i.g.	0	9·0	0	7·0	50	50	0	5·0	0	6·7	48	39·5
Maximum inert-free gas partial pressure, atm abs	1·01	0·90	1·02	0·79	4·34	2·44	0·76	0·51	1·01	0·65	4·21	1·41
Average cracking temperature, ° F	1,470	1,659	1,470	1,592	1,470	1,429	1,460	1,575	1,400	1,539	1,400	1,406
Residence time, sec.	2·42	—	4·24	—	5·47	—	2·80	—	4·11	—	7·05	—
Net B.t.u. recovery, thou'. B.t.u. per gal.	94·5	93·4	101·2	102·4	79·1	48·1	73·5	74·5	73·8	73·1	64·3	48·9
H_2 reacted, cu.ft. per gal.	9·7	16·4	7·7	3·1	16·2	29·0	—	—	5·0	11·4	15·5	30·0
Product distribution, wt % :												
Gas	64·0	60·3	62·3	63·1	50·6	31·7	38·8	39·0	42·8	41·9	37·6	30·7
Liquid products	35·0	39·7	30·4	33·9	42·5	55·5	49·1	55·3	45·0	51·5	49·2	50·3
Coke	1·0	0	6·4	3·0	6·9	12·8	12·1	5·7	12·2	6·6	13·2	19·0
Inert-free make gas :												
Composition, mole % :												
Hydrogen	36·3	36·1	36·8	32·2	29·0	31·2	19·6	24·7	43·2	44·5	36·7	40·3
Methane	28·0	30·4	32·4	34·2	44·8	39·9	39·5	40·6	26·2	22·6	39·2	35·4
Higher paraffins	4·8	2·6	4·2	2·3	9·1	5·9	4·3	3·0	5·6	3·5	9·5	5·2
Ethylene	22·7	23·9	20·1	22·7	12·0	15·1	24·5	23·4	15·0	17·7	9·8	12.3
Higher unsaturates	8·2	7·0	6·5	8·6	5·1	7·9	12·1	8·3	10·0	11·7	4·8	6·8
Heating value, B.t.u. per cu. ft.	1,078	1,040	1,042	1,121	1,034	1,064	1,278	1,162	1,020	1,044	964	970

increase in feed hydrogen utilisation than in the equivalent tube furnace tests.

In contrast with this behaviour of the residual oils, increases in make pressure when using distillate (No. 2) fuel oil resulted in much smaller decreases in net B.t.u. recovery and gas yield, and a decrease in the quantity of hydrogen reacted. These differences in gasification characteristics were probably due to the combined effects of more complete vaporisation of the distillate oil, and to the severe cracking required to maintain high conversion of this oil to gas at the higher pressure levels. The decreases in hydrogen utilisation with increases in pressure had not ben observed in earlier tube furnace studies with distillate oils where more uniform cracking temperatures were maintained.[15]

Comparable Results

It can be seen from Table 2 that at low pressure (below 10 p.s.i.g. maximum make pressure) the results obtained in the tube furnace and in the cyclic pilot unit were comparable for all oils. However, average cyclic cracking temperatures did not correspond to continuous tube furnace temperatures. At these low pressures, cyclic cracking residence times were in the 3 to 4 second range, which approaches the range found in commercial operation and used in the tube furnace tests. At higher pressures, cyclic pressure and gas flow variations made an evaluation of pilot unit residence times impractical, although they were, undoubtedly, extremely long, especially in residual oil operation.

The behaviour of residual oils seems to be closely related to the extreme non-homogeneity of cyclic cracking which must exist under presure. Because the reaction mass is essentially stagnant during most of the oil introduction period due to the slow rate of pressure build-up, a large portion of the make oil must crack in the liquid phase at excessive residence times. This analysis is supported by the observation of unusually high 'coke' laydowns in cyclic pressure operation with residual oils. Further, Fig. 4 shows that, for residual oils, the calculated carbon : hydrogen weight ratios of the non-gaseous products (liquid products plus deposited coke) decrease with increase in pressure. This indicates that some of the large utilisation of feed hydrogen in presure operation with residual oils may be due to liquid-phase hydrogenation. Although the available liquid products analyses are not sufficient to support this trend very clearly, these analyses suggest decreases in free carbon content and increases in sulphonation index when pressure is increased in the presence of carrier gas hydrogen.

Although the influence of maximum make pressure was found to be most readily definable, systematic effects of cracking temperature on low pressure hydrogasification results were also observed. With reduced crude oil, net B.t.u. recovery generally increased with decreases in average cracking temperature and increases in make gas heating value at low make pressure. The reverse effect was noted with No. 2 fuel oil.

Five Critical Burners

The combustion performance of oil gases produced at low pressure, and at 15.5 and 29.5 p.s.i.g., with process hydrogen feed, was determined on five critical burners adjusted for high methane natural gas. The aromatic content of these gases was reduced to 0.3 to 0.6 mole per cent. by freezing out. The procedures for these tests have been described in detail.[29, 30] The results followed the normal trend of increases in make gas substitutability with increases in make pressure due to increases in paraffin content and decreases in olefin content. Overall limiting conditions over the moderately soft (−2) to moderately hard (+2) natural gas adjustment range varied from yellow tipping of the

oil gases with relatively high Wobbe index (heating value divided by the square root of the specific gravity) and olefin content (Runs 38 and 40, Table 1), to flashback on fast turndown of oil gases with relatively low Wobbe index and high hydrogen content (Runs 35-A and 37, Table 1). Essentially complete substitutability was achieved at approximately 30 p.s.i.g. maximum make pressure, and 100 per cent. substitutability, except for transient flashback at moderately hard adjustments, was attained at only 15.5 p.s.i.g. maximum make pressure.

The promising results obtained in the pilot unit with process hydrogen feed have led to a study of methods for lowering the cost of producing hydrogen as this would be necessary if these improvements are to be realised. One method by which this may be accomplished requires a bed of steam-hydrocarbon reforming catalyst in the bottom of each regenerator. If a process hydrocarbon of low molecular weight, and steam are fed into the top of the upstream regenerator during the make period in place of the process hydrogen stream, a hydrogen-rich carrier gas will be produced by catalytic reforming. The other steps of the process would not be changed. Additional heat is required, approximately equivalent to the heat of reforming, and this can be furnished by placing auxiliary heat oil burner in each regenerator. The cost of hydrogen production within the set should be considerably lower than with a separate hydrogen plant, since little additional equipment is required, and sensible heat losses from stack and product gas associated with a separate plant will be minimised. However, additional catalyst development work may be required if the operating conditions have a detrimental effect on the activity of commercial catalysts.

Another method of supplying hydrogen-rich carrier gas would involve placing the catalyst in the generators. In this case, the upstream bed would reform a process hydrocarbon of low molecular weight into carrier gas, while the downstream bed would serve the same function as in the catalyst bed in the high-B.t.u. modification of the CCR process under development by the United Gas Improvement Company.[7, 21] The combination of hydrogasification with cyclic catalystic reforming of petroleum oils may give substantially increased yields of high-B.t.u. gas at suitable operating conditions.

Conclusions

The results obtained in the operation of the cyclic-regenerative pilot unit with a variety of oils indicated that a safe and practical design of commercial equipment embodying the use of hydrogen carrier gas and elevated make pressures could be evolved. It was also shown that the use of process hydrogen carrier gas can increase the high-B.t.u.-oil-gas-producing capacity of a given set with any type of feed oil.

With distillate and reduced crude oils, a part of the additional capacity at low pressure was the result of increased conversion of oil to gas. At moderate make pressures, lower conversions of oil to gas were obtained, especially with reduced crude and No. 6 fuel oil, but high-B.t.u. oil gases which could be quite satisfactorily substituted for high-methane natural gas were produced. In this case, the relatively small increases in capacity were due to conversion of low-B.t.u. process hydrogen to high-B.t.u. oil gas. This was accomplished without additional feed of make oil or tar production.

The present economics of increasing plant capacity by introducing process hydrogen with the feed will depend on a comparison between the cost of installing and operating hydrogen-producing facilities, and of the cost of increasing oil and tar handling capacity, oil storage capacity and generator facilities to obtain the same increase.

Certain equipment design modifications employed in the pilot unit were shown to be practical and to give a better performance than conventional apparatus in high-B.t.u. oil gas production. The 'clean' regenerator design was better for heavy residual oil operation. High blast air preheat temperatures permitted the use of oils of high Condradson carbon residue without the difficulties encountered in conventional sets with excessive coke laydown. The reduction in smoke-forming tendency and resulting elimination of the blow run from the operating cycle produced a gas of low content of inert material and of improved combustion characteristics. It was shown that an installation combining dual product offtake, elimination of hot valves and the quench system employed in the pilot unit could be operated with high Conradson carbon residue oils, and at high severities of cracking.

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BOOK REVIEW

Physical and Azeotropic Data

THE National Benzole and Allied Products Association have recently published a reference book containing certain physical data concerned with hydrocarbons and organic sulphur compounds with a boiling point at or below 200°C.

The bane of organic chemistry is the nomenclature of its compounds. Many of these are known by more than one name, and it is often difficult for the reader who may be familiar with one set of names to be able to identify substances he knows under other names. The author in the introduction has taken a great deal of trouble to make it clear how the relevant data has been laid out in the book, and the type of derived nomenclature which he has adopted. This is most helpful, since it is made quite clear on what plan such nomenclature is based, and once the system has been mastered, any reader, new to it, can grasp not only what type of substance is being referred to, but the exact location of a double bond or a hetero atom in a heterocyclic ring.

D Lines of Sodium

In the first part of the book, physical properties covering the melting point, boiling point, density and the refractive index for the D lines of sodium are given. All temperatures are given in °C. at 760 mm. pressure, the density at 20°C. and the refractive index at 20°C. as standard. To simplify the tables these figures are quoted merely as numbers except where there is any deviation from the stated standard. In that case the pressure or temperature at which the measurement has been made follows the figure and is separated from it by a solidus line.

This particular data has been provided wherever possible for some 1,350 hydrocarbons and covers C_1 (methane) to C_{13} H_{24}. Some 150 organic sulphur compounds have been included covering C_1 (carbon disulphide) to C_{10}, a derivative of thiophen.

Other tables included in the first part of the book give the percentages of carbon and hydrogen in hydrocarbons of the general formula C_n H_m for values of n and m of 1 to 13 and 4 to 24 respectively, and the percentages of carbon, hydrogen and sulphur in organic sulphur compounds C_1 to C_{10}. A list of hydrocarbons and organic sulphur compounds showing their customary names side by side with the systematic names is also included.

The latter part of the book is wholly given over to azeotropic data concerned with constant boiling mixtures containing two, three or four components. The tables are laid out to give data for constant boiling mixtures formed between 14 main substances, which include benzene, toluene, the xylenes, n alkanes, alkenes, thiophene and carbon disulphide, and a number of other substances classified under acids, alcohols, aldehydes and ketones, esters, etc. Included, too, in the table is the literature reference which refers to a section at the end of the book.

Altogether this is a most informative book and should be very useful to all those working in the particular field of benzole refining. It has been compiled in connection with a new edition of *Motor Benzole, Its Production and Use*, the second edition of which appeared in 1938.

Physical and Azeotropic Data, 146 pp., by G. Claxton, M.Sc., The National Benzole and Allied Products Association.

Trade News

Medium-price Cooker with Luxury Finish

THE 'Centurion,' a medium priced cooker, has been introduced by R. & A. Main, Ltd., manufacturers of the popular 'Century' series of gas cookers. Although within the medium price range, the 'Centurion' incorporates many refinements which place it in the luxury cooker class for performance and appearance.

The 'Centurion' is constructed generally of sheet steel, maximum strength with minimum weight being achieved by the use of large panels with deep flanges bolted together. Simplified construction allows easy access to all parts for servicing.

Remains Cool

The hob plate, which can be removed without disturbing the boiling burners, is recessed to accommodate the pan supports and has been specially designed to remain cool in use. The two interchangeable pan supports are of cast iron, finished in black heat-resisting vitreous enamel, and have been designed to allow the free movement of the smallest pans, without tilting, across the whole of the hotplate.

The spillage-resisting boiling burners are cast in pairs, each pair comprising a front and rear burner, and are removable. The anti-spill caps can also be lifted off for cleaning and are interchangeable. Automatic ignition of boiling burners is accomplished by means of a central pilot light which serves a secondary pilot to each burner.

Automatic Re-ignition

The burners will light at exceptionally low gas rates, and thus, in addition to normal automatic ignition the burners will re-light automatically if accidentally extinguished. The fixed injectors, pilot control cock and pressure test point, are all readily accessible when the hotplate parts are removed.

All taps are the spring loaded safety type which must be pressed in before they can be turned on, the four boiling burner taps and the oven tap being situated in the facia and each clearly marked. The backward slope of the facia has allowed the taps to be positioned at a most convenient angle and the indications are clearly visible.

The grill tap is positioned on the backplate conveniently to the right of the grill. Tap fans and Mainstat control knob are in plastic and the design of the fans incorporates a thumb-grip indentation.

All boiling burner taps have a pre-set simmering position which can be felt by a 'check' as the tap is turned from the full on towards the off position. Colour finish of the fans varies according to the colour of the cooker, but in all cases the oven tap fan is in red and the oven door handle chromium plated.

The oven, which has a spring counterbalanced drop-down door, is fitted with a single burner, positioned in a well at the back of the baseplate and has a special easy location device. The flue is near the front of the oven crownplate.

Developments which have been incorporated in the 'Centurion' oven, raise the cooking performance to an exceptionally high level. Among these is the re-shaping of the oven lining to form a fixed stop at the rear of the three lower shelf runners to prevent the bottom shelf from being pushed fully to the rear. This 'staggered' shelf arrangement facilitates temperature distribution under all conditions and ensures adequate and even solo heat.

Elimination of the hotplate well has enabled the oven to be raised to a most convenient working height. The thermostat rod is housed in the flue, grid shelf runners are short and embossed on the linings, and all corners and joints are smoothly rounded. Thus the oven interior is completely unobstructed and is extremely easy to clean.

The combined plate rack and grill cover is of stamped steel, finished in vitreous enamel, with aluminium supporting wires. Three slots on either side of the grill accommodate a total of twelve plates which are warmed by residual oven heat vented in front of the backplate. The forward venting of oven heat also prevents discoloration of the wall behind the cooker and allows flush-to-wall fitting.

The high-level grill is attached to the cooker backplate and can easily be dismantled and removed for cleaning. The grill compartment is almost totally enclosed, an arrangement which results in rapid, even toasting while using substantially less gas than the conventional grill. The grill pan is fitted with

a specially designed handle which remains cool in use; and a two-height grid, cross wired to support small pieces of food, is also provided.

A useful feature is the provision of a large storage compartment in the plinth base, which has a convenient lift-off front and can be used to accommodate meat tins and similar cooking utensils. Removal of the plinth front also permits easy access to the cooker levelling screws.

A gas torch for lighting the grill and the oven burner can be supplied, or alternatively an elbow for connecting a proprietary lighter is fitted.—*R. & A. Main, Ltd., Edmonton and Falkirk.*

New Metal Arch Former for Building

ROWNSONS variable arch can replace wooden arch formers for all building work. It consists of a number of 4-in. metal units, built up to form an arch of any radius from 9¼ in. to infinity (*i.e.*, a flat arch).

A sliding joint in each unit enables its working surface to be set at a slight angle to its neighbour's to form a continuous curving surface. When the joints have been tightened, the arch is securely locked and ready for use. Special end units enable the arch to be fastened to timber or scaffolding tube supports for holding it in position while the building of the permanent structure is in progress.

When the span and the radius of the arch have been formed from the drawing the number of units needed can be found from a table. A strip of some flexible material such as metal or plywood is put over the metal former arch to give a smooth curved surface to facilitate building.

This is especially necessary when deep arches such as long flues or tunnel roofs are being constructed. Here two variable arches are used in tandem and are bridged by a flexible covering or wooden laggings.

Circular windows of 18 in. diameter or above can also be built with the variable arch as a former.—*Phœnix Supply Co. (Croydon), Ltd., 107, High Street, Croydon, Surrey.*

New Pneumatic 3-stage Compressor

THE new three-stage straight line compressors introduced by the Consolidated Pneumatic Tool Co., Ltd., are designed for the continuous compression of air or other gases to pressures of up to 1,500 p.s.i. with a free air delivery of 242 c.f.m. at that pressure. For operating periods of not more than 8 hours, the compressors may be run to give 238 c.f.m. at 2,000 p.s.i.

In principle the new TCB. 3 compressor is a further logical development of the class T design, using a double acting low pressure stage followed by a single acting, opposed second and third high pressure stages.

The type T frame, common to other units in this class, carries a Timken taper roller bearing supported shaft, two sets of bearings being used to equalise end thrust. A wedge adjusted connecting rod of worked end construction transmits the drive to a solid box-type cross-head, which overtravels its guides by half its length, the cross-head face being ground to fit the bore of the guide exactly and properly grooved for effective lubrication.

A piston rod connects the cross-head and the piston, a stuffing box with steel wipers located in the frame prevents oil from being carried out of the crank case on the piston rod.

In the compression section, a double acting first stage piston interposed between second and third stage pistons, acting in opposite directions, gives an almost equally divided load between forward and return strokes.

In operation, air is admitted at atmospheric pressure through Simplate valves to the two compression chambers formed on each side of the piston. Low pressure air from the cylinder is then passed by further Simplate valves to multipass tubular inter-coolers carried above the compressor. Water passes through the cooler in opposition to the direction of the air flow, the coldest water thus being in contact with the coolest air as it leaves.

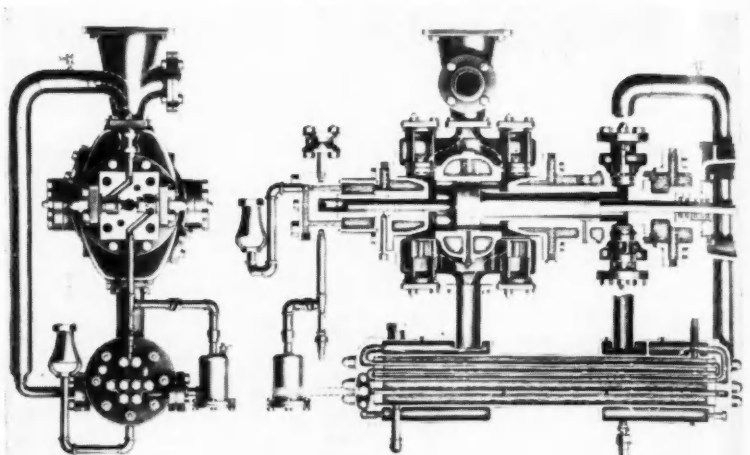


Diagram showing operating principles of the new Consolidated pneumatic T.C.B. 3 compressors.

From the intercooler, air passes to the second stage, single-acting cylinder, this cylinder being located at the crank end. From this cylinder it is further cooled in the second stage multipass inter-cooler tubes before passing to the separator for removal of condensed moisture. The third stage cylinder, of heat-treated forged steel at the outer end completes the compression cycle.

A substantial provision for water jacketing is made to give the much lower operating temperatures than usually obtainable.

A hollow reinforced one-piece casting is used for the first and second stage piston, the third stage piston comprising a hardened steel self-aligning plunger. Lubrication of the cylinder is by a forced feed lubricator, with separate feeds to the first, second and third stages. This force feed is positively driven from the cross-head, automatically supplying a visible regulated quantity of oil to each cylinder.

Metallic packings are fitted where the piston rod passes through the second stage cylinder head. — *Consolidated Pneumatic Tool Co., Ltd., 232, Dawes Road, London, S.W.6.*

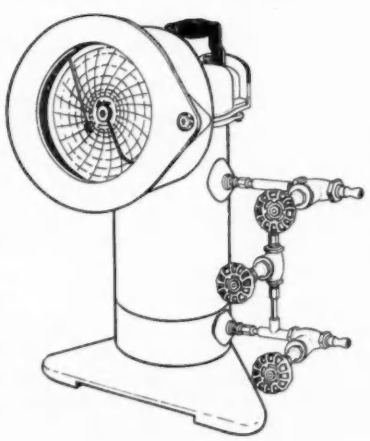
Arkon Portable Gas Flow Recorder

AN interesting addition to the Arkon range of instruments is the portable gas flow recorder which will be on show for the first time at the Fuel Efficiency Exhibition.

The instrument combines the advantage of an efficient recorder with complete portability.

To take a reading the main is drilled and tapped 1 in. gas, a straight pitot tube inserted, and the gas flow recorded in cu. ft. per hour. After the test is completed the pitot tube is removed and replaced by a standard 1 in. gas plug, so that future tests can be easily repeated at the same point if desired.

One instrument is used for different sizes of main by multiplying readings with the appropriate factors from the table provided.—*Walker, Crosweller & Co., Ltd., Cheltenham.*



Hearth Redfyre has Many Fine Features

AN underfloor air-feed fire—to be known as the Hearth Redfyre—is being introduced for the autumn heating season by Newton Chambers & Co., Ltd. It is in effect the grate and underfloor air-feed parts of the Redfyre No. 5 Bacboiler, which has already proved a success since its introduction earlier this year.

The new appliance has therefore the following excellent features: A heat resistant 30% chrome steel bottom grate, reversible for coal or coke; a robust mild steel ashcan which should only need emptying about twice a week; an accurate control lever to regulate the rate of burning; a removable deepening bar for building up an extra deep fire.

Capacity is 1,750 cu.ft. The fire is designed for use with a standard 16 in. solid brick back and suitable for fitting to fireplace surrounds with openings between 18 in. and 22 in high. The fire is available with cream, black or blend mottle vitreous enamel finishes or in a copper or black lustre finish. A fret extension which can be used as a trivet or reversed and used vertically as a safety plate for overnight burning is available as an extra.—*Newton Chambers & Co., Ltd., Thorncliffe, Nr. Sheffield.*

Hydrovane Oil Flooded Rotary Compressor

THE Hydrovane oil flooded rotary air compressor overcomes problems of internal lubrication met with in the design of compressors of the sliding vane type, in addition to difficulties of internal air sealing.

By maintaining the internal oil pressure equal to that of the outlet air pressure, the air pressure forces the oil into the compressor. The oil passes from the sump through a cooler and filter into oil ports in the end covers. These ports are connected to all leakage paths in the compressor which are thus kept full of oil at the discharge air pressure.

In this way all moving parts of the compressor are kept well lubricated and air leakage prevented. The high thermal capacity of the oil ensures that a large proportion of the heat generated by air compression is absorbed, making the cycle as nearly isothermal as possible, with a 15% reduction in power used for compression.

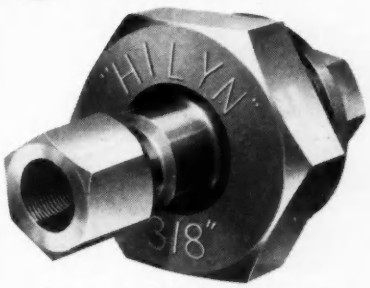
To prevent contamination of the compressed air with oil at the compressor outlet, a special labyrinth removes 99% of the oil. The remainder, in the form of an oil fog, is removed by a special separator and fed back through a patented oil return valve into the in-coming air stream and returned with it to the oil sump.

The air, discharged at 140-180°F. from the compressor, is above its dew point which prevents the moisture contained in it from contaminating the oil circulating through the compressor.

By means of a servo valve, operated by the oil pressure, and therefore the air discharge pressure, the compressor can be worked by modulating control dependent on the load. The compressor is fitted with a minimum discharge pressure valve and a built-in pressure relief valve.—*Whittaker Hall & Co. (1929) Ltd., Radcliffe, Manchester.*

'Hilyn' Self-sealing Swivel Joint

THE 'Hilyn' swivel joint makes possible reciprocating and rotary movement in rigid pipework where the use of flexible hoses is prohibited by the original plant design or space restrictions.



Self-sealing and pre-tension is achieved by the internal pressure with additional support from a specially tensioned spring which ensures that even at very low pressures the joint is completely pressure tight. Automatic adjustment of pipework misalignment is possible through 360° with no restriction in flow. A 10° angular or side movement is also possible.

Simply constructed from B.S.S. gunmetal in five component parts, it is suitable for steam, water, air, etc. The joint may also be manufactured in malleable iron, aluminium or stainless steel alloys where gunmetal is not suitable. It is available in elbow or straight patterns from ¼ in. B.S.P. to 2 in. B.S.P. and sizes up to 6 in. B.S.P. can also be supplied. A P.T.F.E. seal is fitted as standard in every case.

Under authoritative test pressures exceeding 2,500 p.s.i. the joint has remained completely pressure tight, so that for normal industrial applications it can be used with complete reliability under pressures up to 500 p.s.i. and temperatures up to 485°F.—*Hilyn Industrial Equipment, Ltd., Hilyn Works, Lockfield Avenue, Brimsdown, Enfield, Middlesex.*

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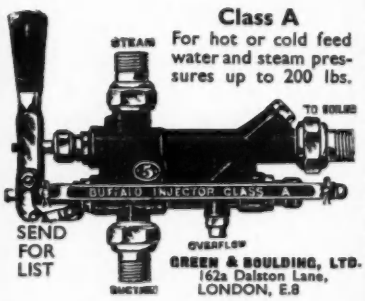

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LOCAL MANAGER—LOUGHBOROUGH UNDERTAKING

APPLICATIONS are invited from suitably qualified persons for the above-mentioned position. The commencing salary will be within Group A of the National Salary Table for Senior Officers (£1,075-£1,195 per annum).

The post is pensionable and the successful applicant will be required to pass a medical examination.

Loughborough is a non-manufacturing unit serving the townships of Loughborough, Shepshed and Sileby. Distribution of gas is the responsibility of another officer.

Applications stating age and present position, and giving details of education, qualifications and experience, together with the names of two referees, should be addressed to reach the Divisional General Manager, Leicester and Northants Division, East Midlands Gas Board, Millstone Lane, Leicester, not later than September 6, 1958.

A. GWYNNE DAVIES,
Secretary.

Beverley House,
University Road,
Leicester.

August 6, 1958.

REPRESENTATIVE, EAST MIDLANDS AND EASTERN GAS BOARDS

WELL known manufacturers of Home Laundry Appliances require a representative for the above Area Boards to commence early October.

Applicants should be familiar with Board Purchasing and Marketing organisations and should have contacts on these boards. Age 30-40 years.

The Company require representatives to live centrally on the area, and applicants should be prepared to move, if necessary.

Basic salary, commission, car and expenses. Full details including present salary, to Box No. 344, *Gas Journal*, 11, Bolt Court E.C.4.

THE GAS COUNCIL

APPLICATIONS are invited for the appointment of HOME SERVICE OFFICER. Her duties will be to assist generally in the advisory service which the gas industry provides for housewives and to collaborate with other organisations having a similar aim. Candidates should have a recognised qualification in domestic science, and experience in the gas industry will be an advantage. Facility in writing and public speaking is essential. The appointment is pensionable, and a medical examination may be required. Commencing salary not less than £1,500 a year. The selected candidate will be required to take up her duties on January 1, 1959. Applications should reach The Secretary, The Gas Council, 1, Grosvenor Place, London, S.W.1, not later than September 15, 1958.

NORTH WESTERN GAS BOARD

MANCHESTER GROUP

SENIOR INDUSTRIAL GAS ENGINEER—INDUSTRIAL CENTRE, WHITWORTH STREET WEST, MANCHESTER

APPLICATIONS are invited for the above pensionable appointment at a salary within the range of A.P.T. 10/12 (£945/£1,070 p.a.). Initial placing within this range will be according to qualifications and experience.

The successful candidate should have had a wide experience in the application of gas for industrial purposes and the selling and installation of industrial gas-fired equipment. Qualifications in fuel technology or in related subjects would be an advantage.

Detailed applications, in envelopes endorsed "Vacancy No. 196," should reach the General Manager, North Western Gas Board (Manchester Group), Town Hall, Manchester, 2, within 14 days.

WEST MIDLANDS GAS BOARD

BIRMINGHAM & DISTRICT DIVISION

ASSISTANT MECHANICAL ENGINEER

CANDIDATES should have served an apprenticeship in engineering and have had further experience in general engineering and steam plant. Possession of an Engineering Degree, Membership of the Institute of Mechanical Engineers or a Higher National Certificate is essential. Some knowledge of mechanical handling plant and/or experience of Work Study as applied to maintenance work would be an advantage.

The person appointed will be required to assist in the maintenance work on Gas Works plant and the installation of new plants.

The salary will be in accordance with Grade A.P.T. 12 (£945-£1,070 per annum) of the National Salary Scales for Gas Staffs.

The post is pensionable and the successful candidate may be required to pass a medical examination.

Applications, stating age, training, qualifications and experience, together with the names of two referees, should be sent to Mr. J. E. Wakefield, Divisional General Manager, West Midlands Gas Board, Gas Offices, Edmund Street, Birmingham, 3, **to reach him not later than September 6, 1958.**

J. SWAN,
Secretary to the Board.

SCOTTISH GAS BOARD

GLASGOW AND WESTERN DIVISION

GREENOCK, GOUROCK AND PORT GLASGOW DISTRICT

APPLICATIONS are invited for the post of Office Manager, Greenock, Gourock and Port Glasgow District, Glasgow and Western Division.

Applicants, who should preferably possess a recognised Accountancy or Secretarial qualification, must have experience in the supervision of office staff (including females), and possess a knowledge of general office functions with particular reference to the handling of large scale customer accounting.

The successful applicant, who will be required to work on his own initiative, will be responsible to the Divisional Controller of Finance and Administration for the successful administration of the District and for all local accounting and statistical records.

The post, which is pensionable is remunerated within Grade APT. 9 (Provincial 'A'), £795 to £895 per annum.

Applications marked 'OM/G,' stating age and giving particulars of education, training, qualifications and experience, should be addressed to the **Personnel Officer (G.J.), 9, George Square, Glasgow, C.2,** within 14 days of the appearance of this advertisement.

NORTHERN GAS BOARD

PENSIONS OFFICER

APPLICATIONS are invited from suitably qualified persons for the above appointment at Board Headquarters.

The commencing salary will be within the range of Group 'B' Senior Officers' Salary Scales £1,155-£1,315 per annum.

The post is pensionable, and the successful applicant may have to pass a medical examination.

Applications, stating age, experience, and giving full details of training and qualifications, together with the names of two referees, should be submitted to the undersigned not later than September 1, 1958.

JOHN F. JACKSON,
Secretary.

30, Grainger Street,
Newcastle-upon-Tyne, 1.

NORTHERN GAS BOARD

(TYNESIDE DIVISION)

DOMESTIC GAS SALES MANAGER

APPLICATIONS are invited for the position of Domestic Gas Sales Manager to the Tyneside Division of the Northern Gas Board.

The successful candidate will be responsible to the Divisional General Manager for the control of all domestic gas sales staff, the promotion and co-ordination of domestic appliance sales, and for consumer service activities throughout the Division.

The Division supplies approximately 284,000 domestic consumers, and in addition to the main showroom situated at Newcastle, there are nine district showrooms. The person appointed will assume full responsibility when the present Sales Manager retires in February, 1959, and during the intervening period will work under his guidance.

The salary will be within Group 'B' (£1,155-£1,315 per annum) of the National Salary Scales for Senior Officers.

The successful candidate will be required to pass a medical examination and join the Board's Staff Pension Scheme.

Applications in duplicate accompanied by a recent photograph, and the names of two referees, should be received by the undersigned not later than 14 days after the publication of this advertisement.

Applications received in response to the previous advertisement need not be re-submitted.

W. SUTCLIFFE
Divisional General Manager.

30, Grainger Street,
Newcastle-upon-Tyne, 1.